

CHEMISTRY



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Precious Chemical Resource

Iron, coal, oil and a thousand other materials are important raw resources for the world's growing chemical industry.

It is the essential atoms and molecules.

More than these chemicals themselves are the brains, skill, enthusiasm and industry of the research workers, those who create new industries and keep the older ones productively young.

There is great concern today about the maintenance of the supply of creative scientists and an increase in the numbers of those who are receiving scientific and technologic training.

Some of those who have seen the power of chemicals in our future have been attempting to do something about this situation for the past decade or more. The youth science movement, which Science Service has catalyzed with thousands of science clubs, the National Science Talent Search, and the National Science Fair has been directed toward this goal.

Great chemical industries, both in the public interest and to assure continuous supply of the manpower that they need, are beginning to emphasize the need and opportunities for chemistry and chemical engineering as a career. The American Chemical Society is bringing its committees and sections to bear on this need. These are timely efforts.

Renewed emphasis upon the *fun* as well as the importance of chemistry will bring results in the six golden years of education, the years of the junior and senior high schools, grade 7 to 12, inclusive. Age 10 or 11 is not too early for future chemists to get started, with more drive and enthusiasm than older people can muster. This is a prime endeavor of the science club method.

Formal courses in chemistry, as well as mathematics, physics and biology, must be available in high school. All too often they have been forced out of the curriculum by well-meaning but unscientific pressure groups and school administrators. Chemistry and other science must be intelligently presented in the general science courses which often are the sole contact with science of the student who does not take to science.

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Chemistry for Youth

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▶ A LACK of technical manpower has aroused industry and schools alike to the need of many more capable young people looking forward to work in science and technology as careers.

Never before, we are told, has the future been brighter for those who are willing and able to prepare for work in research, development and production in science and technology, particularly chemistry.

Participation in science during high school will not be alone preparation for a job. It will be an interesting hobby. Even those who do not expect

to become chemists or other scientists professionally will have fun and learn things that will help them no matter what they finally choose as their future life work.

Thousands of high school students will do projects in chemistry and related sciences this school year. Many will do their experiments and inquiries as a part of their class work. But many more will undertake chemical projects as a hobby because it is fun and they want to do them.

The science club stimulates students and teachers to cooperate on science



▶ AN ORIGINAL process for printing patterns on acetate and viscose rayon won for Miss Doris Jean Hermes, 16, sophomore at Martinsville, Va., High School, the top physical sciences prize for girls at the Third National Science Fair, held at Washington.

outside the classrooms as well as in it. There are about 15,000 science clubs in the nation's secondary school's, public, private and parochial.

Increasingly the members of these clubs affiliated, without charge, with Science Clubs of America, have the opportunity of showing their projects in the spring at one or more science fairs or exhibitions.

Within a school the science projects are assembled into an exhibition which the fellow students, parents and neighbors can see. This is the high school science equivalent of the old-fashioned country fair for farmers.

The best of the projects in a school are sent to the city or area science fair of their locality, which often contains hundreds of exhibits covering the whole range of science, health and technology.

Teachers, school systems, colleges, newspapers, museums, scientific and engineering societies cooperate in the science fairs. From the local fair, the top exhibits, usually those of a boy and a girl, are sent to the National Science Fair, the fourth of which will be held at Oak Ridge, Tenn., on May 7, 8 and 9, 1953.

Each fall thousands of seniors in the nation's high schools enter the National Science Talent Search for the Westinghouse Science Scholarships, making a report on a science project and taking in their own schools a science aptitude examination. The Twelfth National Science Talent Search will culminate when the 40 Washington trip winners meet at the Science Talent Institute at Washington Feb. 26 to March 2, 1953.

Anyone now in high school or interested in a high school student

should urge the student to participate in these science activities if there is inclination to these fields of interest.

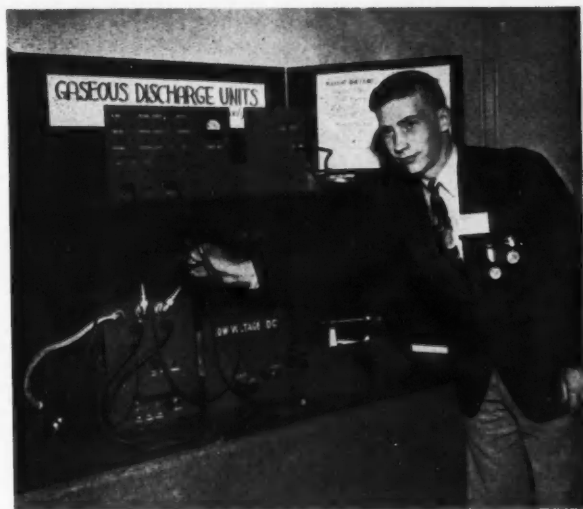
If You Are a Student:

Take leadership in organizing a science club in your school, if there is not already one organized. Join the science club if one exists. Affiliate your science clubs with Science Clubs of America, a division of Science Service, and the national organization to which about a third of a million boys and girls belong. Affiliation with Science Clubs of America is free. Your teachers or any adult who is working with you can affiliate your group by simply writing to Science Clubs of America, 1719 N Street, N.W., Washington 6, D. C., saying: "I want to affiliate my science club with Science Clubs of America. Send me without charge your big sponsor's handbook and other helpful hints on how to assist the members in their science projects." Get started on your science project. Try a simple one first. Many science projects that have been done by others are listed in the new publication: "Thousands of Science Projects" just issued. They will help you pick out your own experimental hobby activity.

If you are a senior, lose no time in insisting that your teacher arrange your entry in the Twelfth Science Talent Search for the Westinghouse Scholarships. Write to Science Clubs of America for details. You should be at work on your STS project right now and the examination is taken in early December. Urge that a science fair be held in your school and locality.

If You Are a Teacher:

Respond to the needs of your students by organizing a science club and



► GASEOUS DISCHARGE experiments comprised the project of Raymon P. Oberly, 17, senior at Parkland High School, Allentown, Pa., which won the first physical sciences prize for boys in the Third National Science Fair.

affiliating it as described above with Science Clubs of America. Being a sponsor will not take much time and will be enjoyable in the results obtained and the effectiveness of your aid to the interested students. Participate in organizing science fairs in your school and locality. You will find that other teachers, colleges, newspapers, industries, etc., will help do the job with you.

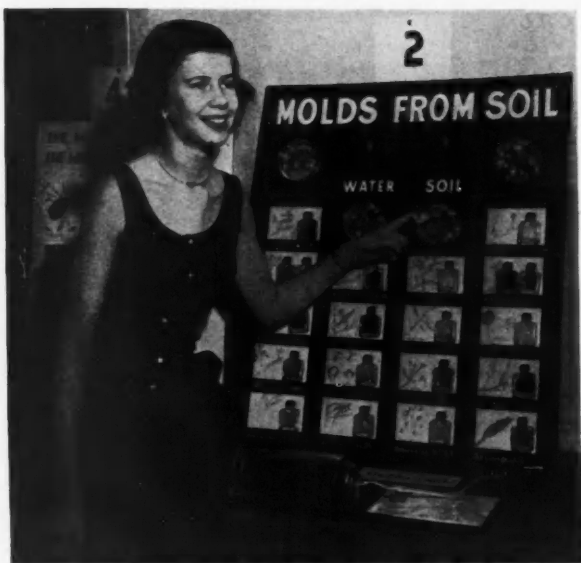
Provide your classes and your club with the aids to their work that will be so helpful. Be sure they read Science Service's publications, not alone CHEMISTRY magazine, but the weekly SCIENCE NEWS LETTER. A bundle of samples sent free on special request. The unique monthly

THINGS of science, a science-of-the-month packet, costing only \$5 a year, will provide material for getting started on projects. Send \$12.50 for a complete collection of 27 intriguing units for distribution to your club.

If You Are a Chemist:

A group of youngsters in a nearby high school will enjoy meeting you and having the suggestions that you as a professional can give them about their chemical hobbies and projects. Make contact with the science club in the high school that your children attend or will attend. The teacher, too, will appreciate and welcome your interest and participation.

Arrange for your company and your ACS section to participate in organiz-



➤ *MOLDS, WHICH are the source of chemicals that cure, were grown from her own back yard soil by Miss Gretchen Koosmann, 16, junior at the South Pasadena-San Marino, Calif., High School, to win the top biological science award for girls in the Third National Science Fair.*

ing a local science fair. Science Service will help you in "know-how" and will arrange other cooperation in your locality.

If You Are a Parent:

Be sure that your children and the children in which you are interested have the opportunity of early contact with science as a hobby. It will mean much to them and to the nation's future. Start them early. And you can inspire teachers and others to join also in this pleasant and essential activity.

In spite of the fact that the sponsor is the most potent force in the func-

tioning of a good club, it is a mistake to have the club "run" by the sponsor. The responsibility for the operation of the club program must be neatly partitioned among the members and the sponsor so that the latter is generally the adviser and the members have ample chance to enlarge their sense of responsibility to duty and to practice the methods of leadership which are essential today. There is no rigid recipe for conducting a science club. Ideas and suggestions gleaned from the experiences of thousands of science clubs over a period of years will help you to avoid some errors.



► THE LIFE CYCLE of a tropical fish, the Three-Spot Gourami, was studied by Elton Stubblefield, 16, junior at Denton, Tex., Senior High School, to win the top Loy's biological sciences award in the Third National Science Fair.

Best Job Outlook for Chemists

► HIGH SCHOOL students are being urged to prepare for careers in chemistry or chemical engineering when they enter college.

The outlook for jobs in these fields during the next five to ten years is the best it ever has been, Charles S. Munson, chairman of the board of the Manufacturing Chemists Association, Inc., has declared.

There is an increasing shortage in the number of chemists and chemical

engineers who are available to the chemical industry. A factor is the fast growth of the industry over the past few years, a growth which will continue in the opinion of the industry.

"In view of U.S. dependence on science for both military security and civilian living standards," Mr. Munson said, "the present and probable future shortage of trained chemists and other technologists has become a matter of real concern to the country at large."

Opportunities, Work, Pay and Necessary Training for Chemistry

Shall I Study Chemistry?

To help answer the questions that students in high school ask about chemistry, the American Chemical Society, the professional society with some 66,000 members, has prepared information about the profession of chemistry and training for this work. CHEMISTRY, as a part of the responsibility of informing students, teachers, parents and others about the opportunities of chemistry, reprints portions of this A.C.S. statement.

What Chemists Do

► CHEMISTRY in this chemical age is itself highly specialized. The American Chemical Society has twenty divisions organized on the basis of subject interest. For example, the organic chemists, who study compounds containing carbon, belong to one division. The analytical chemists are interested in determining the exact amounts of elements in chemical substances and they have formed another division. The chemical engineers have still different interests, and a separate division, since they are concerned mainly with chemical processes and with the design, construction, and economic operation of equipment for carrying them out. Because of these rather wide variations in interest, divisions meet in separate rooms at the large national meetings. You could obtain a good picture of each field by interviewing members of these various divisions. Let us assume that this was done and that the first person encountered in each division was asked: "Will you

please tell me briefly the type of work you are doing and how you like it?" Answers like the following would be given:

Agricultural and Food Chemist:

"I work for a company that pioneered in the development of ready-mixed foods. I was fortunate in getting into the group working on this project when it first started so I know about the many problems which had to be licked before our products could be placed on the market. I have worked on application research and development of ready-mixed food products ever since receiving my master's degree in organic chemistry four years ago. Tell your mother that we will take part of the credit for the half hour she saves every time she bakes a cake with a prepared mix. My work gives me a great deal of satisfaction, partly because it involves such a variety of problems and partly because it is of practical value to so many people." Someone else would talk to you about insecticides, or quick freezing, or any one of a hundred specialties.

Analytical Chemist:

"I have a bachelor's degree in chemistry and have been employed by one of the large petroleum companies for about two years. So far I have performed about thirty different standardized tests on gases, gasoline, and lubricants. Next month I expect to be shifted to tests on greases and before the year is over I will have run all the

analytical tests in the plant. This is necessary to get a good understanding of how one test relates to another and to get a broad training in refinery operation. After a few years I hope to become a supervisor of the group doing gas analyses since these seem to interest me most. I have enjoyed all my work except when it was necessary to work on the night shift. However, refinery operation is continuous and someone has to be on duty every hour, day and night, and I really do not mind taking my turn occasionally." Others in this field would have told of experiences in determining extremely small quantities of material, or of elaborate and delicate equipment they must use expertly.

Biochemist:

"I am a biochemist and have a doctor of philosophy degree in biochemistry. I am employed by a large university hospital which is carrying out fundamental research on the healing of wounds—studying the effects of foods, drugs, and chemicals on animal tissues. Biochemistry involves a combination of biology and organic chemistry and there are certainly some very interesting jobs in this field." A number of biochemists are also employed in industry, teaching, and in government work and any of these might have been encountered.

Chemical Education Representative:

"Three of my college associates and I are attending this meeting to present papers, get new ideas on how to do a better job of teaching, learn of new developments in our special fields, and to meet old friends and gain new ones. My specialty is physical and inorganic

chemistry, which I enjoy teaching. For several years I have been doing fundamental research in addition to my teaching duties. Some of my research has found application in the field of atomic energy where my main concern has been uncovering new facts and developing new theories without immediate concern as to their utility. After several years of rather successful research I am in complete agreement with Frederick the Great, who said 'The greatest and noblest pleasure which men can have in this world is to discover new truths; the next is to shake off old prejudices.' Certainly a professor in an educational institution in this free country of ours has a golden opportunity to enjoy these great pleasures, as well as a third and equal one of working with young people and contributing to their education."

Chemical Literature Representative:

"My work involves mainly searching the literature to determine what has been done in some specified field so that the researchers in our organization need not spend precious time finding out what already is known. In addition, it is my duty to review all scientific publications in certain fields of chemistry as they appear and to bring important articles to the attention of our research men. This requires a broad knowledge of chemistry and complete familiarity with its vast literature. I went into literature research because I enjoyed it and it is particularly suitable for women. This is far from the only field of chemistry open to women but I happened to like it better than cosmetics chemistry, biochemistry, technical secretarial work, analytical chemistry, or other activities

where women also find good positions."

Industrial Chemist:

"At the moment I am doing technical sales and service work. You see when a new product is placed on the market the salesman must know where and how it can be used and he must tell the potential customer what it might mean to him; but it is not only necessary to sell but also to take care of problems which the users have. No product is perfect, partly because it is impossible to foresee how it will react under all possible conditions, and partly because it often is not used as the manufacturer specifies. When this happens it is necessary to have a person with technical training figure out what went wrong and what can be done to remedy the situation. As a matter of fact, my master's degree in chemical engineering and twelve years of experience are often extended to their limit to figure out some of the knotty problems. That's what makes my job so fascinating. It is more interesting to me than any other positions that I have held with this company as a process engineer when we were developing our first continuous process for making synthetic rubber, and then as production engineer after the process was put into operation on a large scale. I have also had something to do with the pilot plant stage which is the middle sized operation between the research done in the laboratory and the large plant operation. I prefer my present job but, fortunately, a lot of chemical engineers do not agree with me and prefer jobs like the previous ones I have held."

What Branch of Chemistry?

After interviewing six chemists and chemical engineers from six different divisions you no doubt would be convinced that chemistry and chemical engineering cover a very broad field and present a variety of jobs. If the other fourteen divisions were visited you would run into some repetition but also a great expansion of the types of work. Patent attorneys, editors, authors, personnel men, administrators, college students, and college presidents would also be found among those interviewed. In fact, an education in chemistry or chemical engineering is an ideal background for a variety of professions. For instance, many medical doctors, dentists, nurses, patent attorneys, technical writers, geologists, and metallurgists began by taking a chemical training. A good training in this general field is excellent preparation for many undertakings or professions (including that of the "home engineer" or housewife).

Working Conditions

Many changes in working conditions have occurred since 1669 when J. J. Becker said, "The chymists are a strange class of mortals impelled by an almost insane impulse to seek their pleasure among smoke and vapor, soot and flame, poisons and poverty—yet among these evils I seem to live so sweetly that may I die if I would change places with the Persian King."

It is true that chemists still work with "smoke and vapor, soot and flame" but modern laboratories are equipped with excellent exhaust systems and the scientist can be working within a foot of a foul smelling vapor and scarcely be able to detect it. It is

also true that chemists work with poisons but there is little danger involved if the precautions dictated by experience are observed. Laboratories are well equipped and safety precautions are enforced.

A forty-hour work week, Monday through Friday, is general. However, chemists are ordinarily not hourly employees and it is often necessary and desirable to work extra time to finish a project. Research problems do not respect a clock and it may be necessary to follow the results of an experiment after the whistle blows or on Saturday or Sunday.

The "poverty" statement in the quotation above is no longer true. While few chemists and chemical engineers may have become millionaires, certainly none need to become public charges.

Salaries

Since most chemists and chemical engineers are salaried employees, they can plan on relatively stable incomes that are not so greatly influenced by economic changes as are those of some professional men who are in business for themselves. While the average chemist or chemical engineer suffers less in depressions, he is not able to capitalize to a great extent in a period of prosperity. Salaries vary with economic conditions and in response to the economic laws of supply and demand. In early 1952 starting salaries for well-qualified, inexperienced chemists and chemical engineers with various college degrees were about as follows: B.S., \$325 per month; M.S., \$375 per month; and Ph.D., \$500. The increase in salary is generally on the order of \$15 to \$25 per month for

each year of service. These are naturally approximate figures and they vary with the excellence of training, the ability, and personality of the graduates and also with the location of the position, the type of industry, the responsibility exercised, and other similar factors.

It is, of course, impossible to predict what the salary ranges will be in the future. However, there is every indication that the demand for chemists and chemical engineers will exceed the supply for quite a number of years. Under such conditions it is expected that salaries will continue to increase.

Qualifications for Success

No one can draft rigid specifications for success in chemistry or any other profession or pursuit. However, there are some qualifications that are indispensable.

Have you found an interest in developing pictures, repairing and keeping up your bicycle, amateur radio sending and receiving, or "tinkering" with the family car? Have you a natural curiosity to know why things happen? Have you enjoyed the study of science and mathematics in school? Does it challenge you to attempt to solve problems which you don't understand? Do you like to do things with your hands, build apparatus, and perform experiments? If your answer to most of these questions is "yes," you should definitely think about chemistry as a career.

Chemistry is an exact science much the same as mathematics. Thus you must have an orderly mind and like exactness. But unlike mathematics, chemistry is an experimental science

and therefore the prospective chemist should enjoy doing things with his hands as well as with his brain.

In common with all other sciences, chemistry requires a high degree of intellectual honesty. You must be prepared to give up preconceived ideas on any problem if experimental facts show that these ideas are wrong.

Other important personal characteristics are curiosity, initiative, and a keen power of observation. Curiosity will continually present new problems and initiative will reveal possible ways of solving them. However, unless you are alert and observe every experimental detail, the clue needed for the successful solution of the problem may be missed.

It is important to realize that most problems in chemistry are not solved by the first effort. Indeed, many of them have required years of work by a number of people. Thus a chemist must have more than average patience and a capacity to work steadily on a job without becoming discouraged. Because modern research is organized so that most problems are attacked by teams, it is very important that a chemist be able to work with others and that he be willing to consider their suggestions as he would his own ideas.

Preparation for College

What is commonly called a college entrance course should be taken in high school if you expect to major in chemistry or chemical engineering. Once a college has been chosen, all the courses specified in its entrance requirements should be included.

Most high schools allow some variation in the college entrance course. If

so, select as much science and mathematics as possible. These will give a good preparation for college studies and at the same time will help determine whether or not chemistry is the science of greatest interest. Other subjects must not be neglected and they will not be if the specified course of study for college entrance is pursued. It is important to emphasize that a good foundation in English is essential. While English is rapidly becoming the language of science, a foreign language (German preferred) is also desirable since valuable literature appears in other languages.

An important problem is the selection of a college or university. This should be discussed with high school teachers and vocational guidance people and also with chemists or chemical engineers. Information can be obtained from national organizations. The American Chemical Society has a list of approved departments of chemistry and chemical engineering. A college education is costly and time consuming and it is important that this investment give the greatest possible return.

Chemistry in College

Once you start majoring in chemistry in a college or university your work is outlined to some extent. In addition to such courses as general, analytical, organic, physical, and inorganic chemistry, you will be required to take college algebra, trigonometry (unless such courses were taken in high school—some colleges require them for entrance), analytic geometry and calculus in the field of mathematics, one or two years of physics, about the same amount of language, and courses in college English,

history, economics, psychology, and social sciences to round out the college education. Majors in chemical engineering will not always take as many courses in chemistry but they will also study engineering drawing, chemical engineering unit operations, engineering thermodynamics, chemical engineering processes, mechanics of materials, and other engineering courses. Each course will be a challenge and an important step in preparing for the job to be held after graduation.

Many chemists and some chemical engineers continue in graduate work after receiving a bachelor's degree and obtain either a master's or a doctor's degree. The master's degree usually requires one or two years beyond the bachelor's degree, while the doctorate usually requires three or four years of graduate work. In graduate school additional course work is taken in advanced studies but greater emphasis is placed on original research which must be the basis of a publishable thesis. Generally only those who are capable of carrying out independent research are encouraged to continue

in graduate work. If one is interested in graduate study the final decision need not be made until the junior or senior year in college. Undergraduate work will be essentially the same in either case.

More Information

More complete guidance information may be obtained from a 40-page booklet, entitled "The Chemical Profession—An Educational and Vocational Guidance Pamphlet" (\$0.25 each for 1 to 24 copies, \$0.15 each for 25 or more copies) or a collection of 29 articles on "Careers in Chemistry and Chemical Engineering" (\$1.00 each for 1 to 24 copies, \$0.75 each for 25 or more copies). The first article in the latter publication contains a bibliography of over 120 references which cover the printed literature in the field through 1950. Other articles deal with the selection of a career, training for it, making a sound start, and descriptions of specific types of positions. Both publications are available from American Chemical Society, 1155-16th Street, N.W., Washington 6, D.C.

Sulfur Controls Lifted

► INCREASED supplies of sulfur have caused the National Production Authority to end controls on distribution of sulfuric acid.

The agency increased the amount of sulfur a manufacturer may keep on hand for future use. As a result, a sulfur user may keep a 60-day inventory. He was formerly limited to a 25-day supply.

Sulfuric acid controls, which have been in force since December, required

sulfuric acid producers to sell the same percentage of their output as they had sold in 1950. When the sulfur supply became tight last year, many producers kept the sulfuric acid they produced.

In ending controls, the NPA said sulfuric acid supply and demand are better balanced than they were eight months ago.

All users of sulfur are still restricted to 90 per cent of what they used in 1950.

Chemical Angles on Health

In every day living there are many cases where knowledge of the chemical facts will save injury and even life. Jane Stafford, Science Service medical writer, tells some of the things you need to know.

Monoxide Poisoning

➤ WHEN THE WHOLE family comes down with nausea and vomiting, it is likely to be put down to "something they ate," or food poisoning. But some of these cases may be due to poisoning with carbon monoxide gas. This colorless, odorless gas gives no warning of its presence and is a sure killer if the dose is high enough. But in lesser concentrations it may only cause sickness.

Quite a few outbreaks of disease reported to the New York City Department of Health as food poisoning have, on investigation, been found due to carbon monoxide poisoning. Dr. Harold T. Fuerst, epidemiologist of the department, reports. Nausea and vomiting are symptoms of both, hence the confusion, he points out. He gives the following points of difference:

Diarrhea is the rule in food poisoning and rare in gas poisoning. The reverse is true of headache. Weakness and vascular (blood vessel) collapse occur early in gas poisoning; they occur late in food poisoning as a result of severe vomiting, diarrhea and the consequent dehydration. The patient with food poisoning is apt to be pale, whereas the patient with carbon monoxide poisoning is likely to have cyanosis or a peculiar cherry red color.

The epidemiologic picture is different in the two diseases. In the case of food poisoning, a group of people who have partaken of a common meal become ill within a limited range of hours from the time the meal was eaten. In carbon monoxide poisoning the people involved became ill almost simultaneously, and there may have been no common meal. An experienced epidemiologist will suspect gas poisoning if he finds the ill patients in crowded quarters, with all windows closed. A little investigation will often disclose an open, unlighted gas burner, or a defective gas heater or gas refrigerator or a leaking gas pipe. The accidents occur chiefly at night when the patients are asleep and not alert to minor symptoms.

Cleaning Fluid Danger

➤ HOUSEWIVES and others who do dry-cleaning at home should be careful if they use cleaning compounds containing carbon tetrachloride. These have the advantage of being non-flammable, so the fire danger is avoided. But if the fumes are inhaled or the fluid is accidentally swallowed the chemical may cause rapid poisoning.

This warning comes from the New York City Board of Health which requires that such cleaning compounds be labelled with special warnings against misuse.

The early symptoms of carbon tetrachloride poisoning can be headache, nausea, vomiting, loss of appetite or jaundice. Continued exposure to the

chemicals can damage the liver and kidneys and may result in death. Different individuals have varying susceptibilities to carbon tetrachloride. What makes one person seriously ill may not have the same effect on another. Persons who have been taking alcohol are particularly susceptible to the poisonous effects of carbon tetrachloride.

Other factors which determine the degree of damage carbon tetrachloride may cause are the amount inhaled, the size of the room in which it is used and the amount of ventilation in the room.

"Cleaning compounds containing carbon tetrachloride must not be used in confined spaces or in rooms with the windows closed, but should be used in well ventilated rooms where inhalation of the toxic chemical can be avoided," warns Dr. John F. Mahoney, New York City Commissioner of Health. "In addition cleaning compounds as well as other poisonous chemicals and potent drugs, should be kept away from children."

Accidental Poisoning

► AS LONG AS parents are careless and children are inquisitive there will be accidental poisonings, declares Dr. J. P. Price of Florence, S. C., in a report to GP, journal of the American Academy of General Practice. Since children learn through being inquisitive and curious, it is up to the parents to check their own carelessness if they want to prevent accidental poisoning of their children.

A few of the lessons Dr. Price says all parents should learn include:

1. Keeping all medicine in a special place out of reach of the child.

2. Discarding all bottles and cardboard boxes in which small amounts of old medicine remain.

3. Avoiding the use of soft drink bottles or small glass jars for holding solutions which are harmful if drunk.

4. Guarding against a child coming close to a can or bottle of cleaning liquid or polish which is being used.

5. Keeping the child away from any shrubs or plants which have been sprayed recently.

6. Keeping all insecticides and animal poisons in the garage or barn and never bringing them into the home.

7. Teaching the child the danger of eating the leaves or seeds of growing plants.

But should you have to make a frantic call, "Doctor, what shall I do? Little Mary just drank some floor polish," Dr. Price says the important thing is first to find out what the ingested material contained.

Putting the case in a physician's hands is imperative. While most poisonings are treated by emptying the patient's stomach, certain specific measures should be employed by the doctor to ward off unforeseen side effects. All kinds and cases of poisoning must be treated with respect.

Kerosene, lye, rat poisoning, turpentine, nicotine (eating cigarette stubs), jimson weed, sedatives, excessive aspirin, and insecticides are named by the South Carolinian as the most common poisoning agents.

Spice Salt-Free Diet

► THOUSANDS of persons with high blood pressure and heart disease have been put on a salt-free or low sodium diet by their doctors. To many of

them, especially at first, food tastes flat and there is no fun in eating. Others may put up with the diet for a time, till the monotony of it drives them to cheat a little.

The salt-free diet can be made tasty by the judicious use of spices. That this can be done safely is shown by studies reported by Dr. C. A. Elvehjem and C. H. Burns of the University of Wisconsin to the American Medical Association. They analyzed 100 samples of commercial spices for their salt, or sodium, content.

Out of 41 different spices only five were found to have concentrations of more than 0.1% sodium. And of these, only dried parsley and celery flakes contained enough salt to warrant ruling them out of low-sodium diets, according to the chemists. Many of the spices had between 0.01% and 0.02% concentrations of sodium and most showed less than 0.05%.

For the tests the chemists used samples of natural spices sent to them in regular commercial packages from several different manufacturers. Each sample was analyzed at least two times by means of a flame photometer.

Where the chemists received samples of the same spice from different companies they analyzed each separately.

The list of spices examined ranged from ground allspice to vanilla beans and included anise seed, bay leaves, caraway seed, dill seed, garlic powder, ginger, oregano, pepper, poppy seed, sage and thyme.

Cereals and Milk Together

► "CEREALS AND MILK go together," Dr. E. B. Hart of the University of Wisconsin stressed in a recent report to Nutrition Reviews. He is disturbed because recent findings on the biologi-

cal value of various proteins have been misinterpreted in some quarters.

The biological value of proteins depends on their content of essential amino acids and "possibly," he says, on the rate of release in the digestive tract of these acids. Wheat, corn, rye and barley contain proteins low in one of the amino acids, lysine. If cereal grains constitute the sole article of diet, the protein alone, irrespective of other deficiencies, could not support normal growth of an animal. This has been known for 50 years.

For more than 40 years, scientists have known that cereal grain proteins had to be supplemented with the "better and more efficient proteins of milk, meat or eggs," Dr. Hart points out.

One part by weight of a cereal plus one part by weight of milk will give an efficient protein mixture, he states. Since few persons weigh their food, one can measure by volume, for example, a cup of cereal plus a cup of milk. This proportion applies to any cereal.

Muscle meat, such as steak or roast, glandular organs such as kidneys or liver, and eggs are also excellent protein supplements to the cereal proteins. But in the United States, Dr. Hart observes, they are less likely to be used in the case of young growing animals or children.

So he warns, do not be misled into thinking cereal breakfast foods are inferior or that one of them is any better in protein value than another. Breakfast cereals, he points out, are eaten with milk, only rarely with water alone. Any differences in the biologic value of their proteins is wiped out if they are eaten with the proper proportions of milk, that is, 1:1 by weight.

Army Uses Charcoal and Trioxane to Heat Rations

Smokeless Heat For Food

➤ A BELT of charcoal sticks sewn together with asbestos thread is being developed by the Quartermaster Corps to heat canned rations for soldiers.

Still in the experimental stage, the belt is wrapped around cans of food and is ignited. It burns with a flameless fire, producing little tell-tale smoke or combustion odors, and can satisfactorily heat rations that may be frozen solidly.

Present ration heaters burn with a flame that must be shielded from the wind. They also generate columns of smoke that might pinpoint the soldier's position for the enemy. Sometimes they do not warm the food to an appetizing temperature, especially if the food is frozen.

The flameless fuel unit, as it is called, is a mixture of ground charcoal, iron powder, potassium nitrate, sodium nitrate, sodium acetate, ammonium bicarbonate and copper chromite. Some of those chemicals are added to help the soldier get the fire started more quickly.

The dry powders are mixed together and then the wet chemicals are stirred in. A binder of potato starch holds the material together in stick form.

Although the heating belt is still in early developmental stages, the Army

hopes to produce something workable out of the idea. But at the moment, technicians still are trying new chemicals in the mixture to see how they work.

Another form of "canned heat" being used by the Army is a modified paraformaldehyde called trioxane. The substance is manufactured in pellet form through a continuous process developed by the Celanese Corporation of America.

Pellets of the fuel are packed into what the Army calls an "assault packet." The packets are issued to soldiers who will not be able to eat with their buddies stationed near Army field mess kitchens. The assault packets do not contain what is thought of as "rations," the Army advises, but includes a comparatively good meal to tide the soldier over until he can get back to his outfit.

Trioxane was put on a commercial footing after the Quartermaster Corps asked for an improved "canned heat." Hexamine tablets did a satisfactory heating job, the Army said, but they produced toxic fumes which became a hazard in confined areas.

Trioxane probably will be produced in excess of military requirements and commercial quantities will be made available to civilians for developmental work.

Paper with high tensile strength both when dry or wet is now being made of a regular paper pulp to which neoprene, a synthetic rubber, is added in latex form.

Ten Miles From A-Bomb Zero

Only three atomic bombs have been viewed by those who could report what they saw. Of these, Operation Big Shot whose atomic bomb exploded in the air over Yucca Flat, Nev. on April 22 was most spectacular. The observers were much closer than the reporters at the two Bikini blasts. One of the editors of CHEMISTRY magazine (H.M.D.) witnessed this top chemical event. Here is her story, which begins with a tour of the elaborate site of the testing ground in one of the most desolate parts of our nation:

► **STANDING** ON Control Point, we looked over the scene of atomic experiments. It is a vast, flat plain, the bottom of an ancient shallow lake, long ago dried up. But early morning light gave it an illusion of wetness, like a mirage.

There is a secret, hidden quality about the place, in spite of its great extent. It is rimmed with misty blue mountains which seem to shift and change with the cloud shadows that cross them. The sand is nearly white.

Boulders and sand form three small hills at one end of the plain. When water covered the plain, these must have been islands. One of them is all rocks, with little sand showing between them. That was News Nob, swarming with camera men on bomb day. The other two are more sandy and, like the desert around them, support some plant life.

Yucca abounds with its stalks of white, bell-shaped flowers. It sprouts sharp green leaves on top of the

column of gray, dead growth of former years. With this are the ribald Joshua trees which grow into vaguely obscene caricatures of human forms—surely an innocent and maligned piece of vegetation. One feels a little sorry for them.

We were driven in buses over the plain, and allowed to file through an underground bunker, which may be the prototype of industrial buildings in the atomic age. Its walls and roof are of thick concrete, and five feet of earth is piled on top of the roof. The doors are metal, and fitted with thick slabs of lead to keep out radiation. The huge bolts on the outside of the doors remind one uncomfortably of medieval dungeons, though the only prisoners are scientific instruments reporting back to Control Point.

"You were taken through one of the underground instrument bunkers," we were told later at a briefing session. "There are others," our mentor informed us. "Perhaps you did not notice them," he added smugly.

If the bunkers are dungeons, Control Point is the castle. It is a mountain fortress where people live and work. Its buildings blend into the rock. There is room to park the cars that take the people back and forth, as the medieval castle yard had room to stable the horses.

Control Point dominates the flats below, on either side, but its moat and drawbridge are miles away. Three installations guard its approaches.

The nearest of these to Control Point, and the closest in spirit, is

Camp Mercury. This is the Atomic Energy Commission's headquarters. It is a big town. Its shining Quonset huts and low, square, pale green houses spread over a considerable acreage of rolling desert.

Here the technical people are based. Here the long-hairs can study over the data that Control Point collects. Here the routine clerical work is done. Here 90 girls who are clerks and stenographers and telegraph operators are often in residence, in a dormitory built for 60. Here are permanent-type homes. Liaison is maintained with the outside world. The sheriff of Clark County is one of the residents.

As at all Atomic Energy Commission bases, security officers must pass you at this gate. You must produce credentials, and prove that you are the person to whom the credentials were issued. Your proof must satisfy cold-eyed young men, turned out with military spit-and-polish, whose sole job is to be suspicious of people.

The road to Camp Mercury turns off Highway 95 at Indian Springs. A saloon, a souvenir stand and a U. S. Air Force Base make up the population of this Nevada town.

Between Camp Mercury and Indian Springs, to one side of the highway, lies the Sixth Army's Camp Desert Rock. A city of olive drab tents on a plain where the wind always blows, the word for Camp Desert Rock is grim. Water has to be hauled in. On the eve of being the first troops in history to experience attack with atomic weapons, their talk was of when the new shower baths would be installed. Desert Rock seems secluded, isolated and shut in.

The airplanes parked along the runways at Indian Springs, on the other hand, promise the freedom of a new dimension. Airmen are the modern counterparts of the wide-ranging knights of old.

The young knights explain the duties of their mechanical steeds. This one is for cloud sampling. That one is being decontaminated. The illusion of magic is strong. To sit in that plexiglas bubble on the other side of the field and be borne aloft by the spidery helicopter must be the height of the fantastic.

Here is part of the world of the future, and some of its implications become clearer as you think about them. This new world already exists in certain places. In a plane you can fly from one of these places to another, ignoring the old world in between. A girl flew in from Los Alamos, who had charge of arrangements and wanted to be in at the finish. Another girl flew down from Hanford. Troops were brought in in a big new plane capable of carrying a whole company at once, 200 seated plus 50 strap-hangers. A speaker from Washington is promised, and he materializes on the platform at the proper moment.

In the world of the future, it is already natural to flit from place to place. How casual will the young knights be about dropping their atomic fire-bombs on the empty space in between? Will they have any understanding that the green and brown checker-board far below houses earthlings that are kin to them, although invisible?

We observers had things explained to us constantly. Military leaders vied

with one another in telling what their troops would do in the atomic bomb demonstration. They parried questions about "how near" and "how much" as a swordsman parries a thrust.

Scientific leaders wanted the newsmen to understand. They drew diagrams of waves and temperatures. They refrained from writing equations. They think in mathematics, the language of the future, and try to translate.

Civil defense officials, as leaders of the earthlings, had the orchestra seats for the show. Each shuddered as he measured off mentally the distances he saw against the plat of his own city. Here is ground zero. The area of total destruction would extend this far. How do you fireproof a fire engine? Here begin the casualties we can do something about. In ever-widening circles the classes of injuries spread out: the first degree, the second degree, the third degree burns.

Learn about the people with radiation sickness who will live an hour, a day, a week. There is no use helping them. Concentrate on those that have a chance. Where shall we cache our blood supply for transfusions? Blood in short supply can be stretched with salt solution. But we can't make use of salt solutions that have become radioactive.

Radiation, the invisible enemy, is everywhere. Fortunately our instruments locate it when it is far too diffuse to do us any harm. Our bodies are accustomed to a certain level of it. Only when the Geiger counter's chatter increases to a roar must we beware. The Geiger is the talisman

that protects us from danger. Earthlings shall collect a variety of these magic charms — the scintillation counter, the pocket dosimeter, the film badge, the cutie-pie.

Impersonally we are governed by the laws of chance. It is fitting that Las Vegas, Nevada, town of slot machines, should have the atomic bomb in its back yard. The same natural law that determines the random jack pot will tell your chance of survival, or of being in the target area when the bomb falls.

As far as your daily routine goes, there is little you can do. The plane that carried the demonstration bomb and its escorts obligingly made vapor trails. If they had not they would have been invisible. They flew very high and very fast.

Our loud-speaker system chilled our souls with the shout, "Bomb away!" An enemy plane would come silently. Would we pick it up by radar, or would we be lulled by too many cries of "Wolf"?

The bomb announces its explosion by a brighter light than you have ever seen. Its flash, dimmed by our dark goggles, filled the field of vision. The sun, seen through the same goggles, is a pale ghost of a moon. If the enemy's bomb falls behind your back, you are lucky. If you see its full glory, you may never see again. It destroys your eyes. After the first intense flash, we observers took off our goggles. Completely dwarfing nature's sun, a new, unnatural globe of licking flames shone in the North.

As this fire dies the familiar shining white mushroom rises from the cinder of dark cloud. The cap of the

mushroom is a gigantic smoke ring. Hot gases billow up through the center and cool at the top to form a glaze of ice. Cloud forms curl down over the outside, preserving the ring form. Luminous white, but tinted with yellow and rose, its unearthly beauty gradually fades leaving a cloud scarcely to be distinguished from the cumulus that dots the blue sky.

All this you might see of an enemy's bomb if you were lucky in escaping the first flash, provided you were ten miles away. A considerable number of seconds later the puff of hot air, the sound of the deep boom and the rush of the blast wave arrive together. And after that, some three miles from the bomb's target, an ominous column of black smoke comes up. This time it was a wooden shed. In Hiroshima it was the fire-storm that destroyed the city.

To the military, the atomic bomb is a powerful fire bomb useful for wiping out enemy strong points. To the scientist, the explosion is a test to learn much he would like to know about how atoms behave and why windows in sometimes one nearby town, sometimes another, are lifted out onto the sidewalk by the blast wave. To the observer, it is a beautiful and fearful sight. If you are a victim, that first vision of unimaginable light will probably be yours. Its equivalent is registered on instruments on the blast site. This message is transmitted to the control point in the instant after detonation, before the instrument that saw the flash is vaporized.

Light travels fast. Heat, sound and blast come slower. Veterans of other explosions tell you to wait, but it is still a surprise when the "boom" of

this big fire-cracker comes. Sometimes the noise is also felt as pain in the ears. If you feel it, you can rejoice. You are alive!

The suffocating heat wave, the blast that pushes you against the rock, are not as bad as you expect. The troops in foxholes nearer the source felt them strongly. At ten miles you feel them as a quick slap, and they have passed on.

The blast wave takes a curious course. Its wave front spreads upward at the speed of sound, far higher than our weather balloons can go fishing. And away up there, in the rarified "deep" of the upper atmosphere, this wave encounters yesterday's weather. Heat rises, and some 80 miles above our heads a layer of hot air soars and falls as the resultant of a lot of conditions.

When the blast wave hits the under side of the hot layer a reflected wave starts back to earth, just as an echo reverbrates from a hill. It is not a transverse wave, vibrating up-and-down as it moves forward. It is a push-and-pull wave, jittering back and forth as it advances—a condensation and rarefaction.

This pressure-followed-by vacuum wave, when it reaches earth, plays hob with plate glass windows. Because they are braced inside against wind pressure, they can stand the 5 lb. per sq. in. pressure of the condensation, but the vacuum that follows lifts them out to crash on the sidewalk. The window displays are not disarranged, but sharp splinters of the flying glass are a hazard to people passing by.

Because weather conditions are constantly changing, even over the desert,

and because the amount of data is still small, the scientists who study the data cannot predict with any certainty which town will get the concentrated effect of the blast wave after an atomic bomb explosion. They can plot the source of the outgoing wave. They have to wait for the complaints to come in by telephone to learn how the wave was reflected from up above.

Tonopah, Nevada, 180 miles away to the north always reports consistently on the effects seen, heard and felt there. Measurements sent in from there represent known quantities in an equation. Variables can be given values according to measurements of what was felt at observing stations in other towns. So the geometry of shifting currents far above us can be worked out.

Damage by blast waves offers the kind of injury civil defense people can cope with adequately. The injuries will be cuts and bruises, possibly broken bones.

Injury by atomic bomb blast would come mainly by fire. On Yucca Flat the target was laid out on the desert sand in concentric rings of lime and charcoal. There was nothing to burn, except these wooden sheds half between ground zero and the soldiers' trench.

We observers, ten miles away, felt the initial heat wave as one feels the radiation when a blast-furnace door is opened momentarily. But in the Japanese cities a similar blast set fire to everything burnable. Ground zero became a huge bonfire, and the convection currents of air rushing inward caused the "fire-storm"—a new term in the annals of holocausts.

After such a conflagration, the chances of assembling life-saving crews and equipment seem slim. Efforts to provide shelter against such disaster seem puny. If you are near ground zero when an atomic bomb goes off, your chance of survival depends upon whether you happen to be beneath some five feet of earth, or behind ten feet of solid concrete. You are not likely to have time enough to get there from any great distance.

It seems evident that, in the case of atomic bomb attack by an enemy, aid would have to come into the disaster area from outside. Civil defense organizations should therefore practice, not so much what they can do for their own communities as what relief they can send to cities ten miles or more away.

Coastal cities have the added hazard of a "near miss" bomb which might fall into the sea offshore. Although the pattern of an explosion followed by the radiation is the same for any bomb, its effects when exploded underwater are very different. They were described to me by an observer who saw the second Bikini demonstration in 1946. No blinding light signals the atomic bomb exploded under water. No fire ball is visible to distant observers. But the enormous energy let loose churns up a vast cloud of radioactive fog which rolls outward at frightening speed. This fog enveloped ships moored around the target area at Bikini. The metal of the ships was afterward found to be strongly radioactive. It remained so for a long time.

At Yucca Flat, samples of army equipment were spread over the ground around the target. The soldiers

in the trenches were to be shown just what the results of the explosions would be for each type of weapon and each type of shelter. This information was of course secret.

If you are an unprotected civilian, your chance of being burned to death in an atomic blast is excellent, if you happen to be close to it. Your chance of dying lingeringly from radiation

damage depends on how far you are from the explosion, and how much sheltering material is between you and it.

There is no denying the fact that the amount of radioactive material in the world is on the increase. What effect this will have on the population of the world is a complex question which only the future can determine.

On the Back Cover

► THE MUSHROOM is the symbol of the atomic bomb. The back cover photograph shows the atomic cloud of the April 22 explosion. In the foreground are the reporters, photographers and civilian defense officials who had just seen the explosion. The long stem of the mushroom leads upward from a darkish cloud that was the enormous ball of flame, a most striking aspect of the atomic bomb which has not received enough attention. In a few hours this distinctive cloud will lose its shape and benignly seem like an ordinary cumulus.

**New Reactors, New Protective
Devices, New Metals Produced**

Progress Along the Atomic Front

Under the impetus of the expanding atomic energy program, many developments are being made.

Uranium Plant in Ohio

➤ AEC WILL construct a new gaseous diffusion plant for the production of uranium 235 in Pike County, Ohio, about 22 miles north of Portsmouth. About 6,500 acres of land are being acquired.

The potential availability of power at reasonable cost in quantities needed for operation of the plant and the availability of water were important factors in selecting the site.

The gaseous diffusion process, designed to separate fissionable uranium 235 from non-fissionable uranium 238, is one in which uranium hexafluoride in gaseous form is pumped through thousands of extremely fine barriers which have literally millions of tiny holes per square inch. Since U235 atoms are slightly lighter and therefore travel slightly faster, they strike the screens and pass through the holes with greater frequency than do U238 atoms. This process gradually separates the U235 atoms.

Operation of the plant will involve no appreciable radiation hazards. In the six years that a similar plant has operated at Oak Ridge, Tenn., not a single employee has suffered a radiation injury. A gaseous diffusion plant operates with no more than normal industrial hazards.

The plant will cost about \$1,200,000,000. It will require up to 400,000

kilowatts of power, to be supplied from existing facilities for early operations. New power plants will be built to supply the maximum of 1,800,000 kilowatts needed when the entire plant is in operation.

Construction of the plant as a whole is scheduled to take about four years.

"Swimming Pool" Reactor

➤ A "SWIMMING POOL" is being used at Oak Ridge, Tenn., to cut down deadly radiations from a low-power nuclear reactor set up to aid development of better reactor shields.

The pool is 20 feet wide, 20 feet deep and 40 feet long, and holds 130,000 gallons of water.

The reactor, an assembly of movable nuclear fuel elements placed on end in an aluminum grid, can be moved about within the pool. It is suspended by an aluminum framework from what is called the reactor bridge, which rests on wheels fitted to rails along either side of the pool.

An instrument bridge also spans the pool and operates on the rails. Using a carriage that slides up and down on the framework attached to this bridge, operators can place test instruments at any point in the pool.

The reactor uses fuel elements designed for the materials testing reactor, a large unit recently put into operation in Idaho.

The reactor, central feature of a bulk shield testing facility, became "critical" on Dec. 17, 1950, and was

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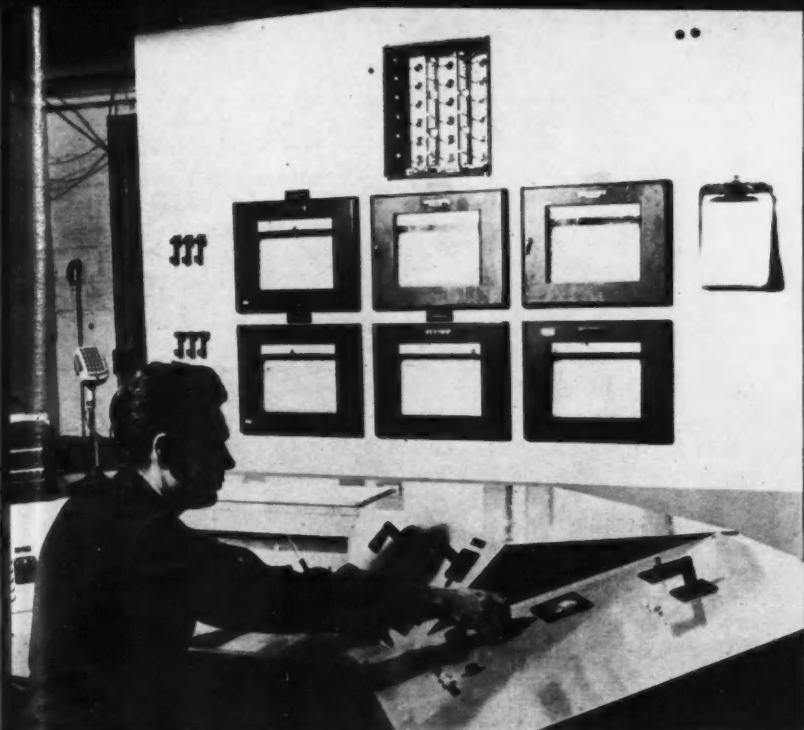
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► **CONTROL BOARD** of the low-intensity test reactor at Oak Ridge National Laboratory. This reactor is for testing radiation effects on construction materials for use in atomic power production.

placed in operation shortly afterward. Exclusive of the uranium fuel, the entire facility was built for slightly more than \$200,000, of which the reactor core itself cost only \$58,400. The rest of the cost was for concrete work, the building and auxiliary equipment.

At the maximum flux, or neutron density, of the reactor, under the full-load power rating of 10 kilowatts, approximately 100 billion thermal neutrons per square centimeter per second are produced.

Because this reactor is an economical and safe producer of radiation as well as low in cost, it is one of several types of reactors that might be suitable for use at schools and other research and training institutions.

Power From Fluid Reactor

► **THE SECOND** atomic energy production of electricity will soon be a reality.

A pilot reactor that has its fissionable material in the form of a mud-like slurry started operation at the Oak Ridge National Laboratory April 15.

A small experimental plant to produce electric power is part of the installation.

First atomic electric power production in a small way occurred when the AEC experimental breeder reactor began operation at Arco, Idaho, last year.

The new Oak Ridge homogeneous reactor is investigating the fluidized method of handling the plutonium or uranium used as "fuel."

California Reactor

➤THE FIRST ATOMIC ENERGY reactor to operate in California is North American Aviation's water boiler neutron source at Downey.

Designed and built by North American's atomic energy research department under contract with the Atomic Energy Commission, the "baby" reactor is being used to further the development of reactors and associated projects.

While the water boiler reactor is quite small in comparison with reactors for producing fissionable materials or useful power, from it may be obtained information of value in designing improved reactors for various purposes. The water boiler is a part of a facility for making reactor physics measurements to enlarge the basic information upon which reactor development is based. The water boiler neutron source will supply the neutrons, minute particles of matter, needed for these measurements.

The reactor is generally similar in construction and physical size to other low power water boiler reactors in the United States. A difference is that the very low power of the reactor at North American, less than one watt, makes

a cooling system unnecessary. A reactor of such small power is not used as a producer of fissionable materials.

The exterior of the reactor is shielded by a housing of two-foot thick concrete blocks each weighing 1,000 pounds, forming a structure about the size of a single car garage. The concrete surrounds a cylindrical graphite reflector five feet in diameter and six feet high, formed by stacking graphite bars horizontally inside a steel tank. The reflector surrounds the reactor core, a stainless steel sphere one foot in diameter. The production of atomic energy takes place inside this sphere which contains a uranium 235 enriched uranyl nitrate solution. It is from the nuclear fission of this material in a water solution that the reactor derives its power, and hence its name "water boiler."

The rate of fission, the production of atomic power, is controlled by a system of control rods which can be moved horizontally through the concrete and graphite to the core. These rods, made of cadmium, boron, and aluminum, have a retarding effect upon the nuclear fission inside the core. Depending upon their nearness to the core, the rods can control the fission from a "stop" to "wide open" rate of reaction. The graphite reflector "bounces back" neutrons which come from the core. Any stray neutrons which escape the reflector are trapped by the concrete and engineers working outside the reactor are shielded from any harmful effects of atomic radiation.

The water boiler type reactor is unique in its safety features. Although the reactor is constructed to be completely controllable by mechanical



► **ATOMIC ENERGY** engineers measure radiation on the North American Aviation water boiler type atomic energy reactor. The reactor is shielded by two-foot-thick concrete blocks. Structure on top is one of many test assemblies which can be used in connection with atomic energy experiments scheduled for the reactor.

means, it has inherent features which contribute to its safety. If the mechanical controls were to fail and a "run away" fission process resulted, heat produced by the process would raise the temperature of the water solution sufficiently to stop power production. At this point emergency control rods could be employed to restore the reactor to a neutral condition.

Materials to be "bombarded" by neutrons and thus made radioactive can be placed inside the core by means of a "glory hole" which connects through a channel to the outside of the reactor. An instrument panel near the water boiler records the amount of radiation for these experiments. The control rods to regulate the rate of power production are also operated from the instrument panel.

Two engineers are required to put the reactor into operation and bring it to the "full power" stage. Only one engineer is needed to keep the reactor in operation, while an additional engineer conducts the test work.

Although the Atomic Energy Commission authorized North American to build the water boiler primarily for reactor research, associated secondary studies in atomic energy technology can also be performed with the aid of the reactor, with applications to medicine, industry and academic research.

Impurities Made Radioactive

► A NEW and highly accurate method of using atomic energy to detect and measure impurities in foods, pharmaceuticals, metals, and other materials, has been developed by Union Carbide scientists at Oak Ridge National Laboratory. The analysis technique, which should help manufacturers to improve

the purity of the final product, is now being offered as a service to industrial, scientific, and medical organizations, by arrangement of the Atomic Energy Commission through Carbide and Carbon Chemicals Company, a division of Union Carbide and Carbon Corporation, which operates the Laboratory for the AEC.

Dr. C. E. Larson, director of the laboratory, explained that the analysis technique involves placing the test sample in the Oak Ridge graphite reactor, or "atomic furnace." The sample is thus exposed to neutron bombardment, and in this way the traces of impurities in the material are made artificially radioactive. Then, using the highly sensitive instruments and detectors developed at the laboratory, the scientists can measure with great accuracy the exact quantities of impurities that may be present.

According to the experience gained thus far in perfecting the method, neutron-activation analysis can be of much practical value in determining minute quantities of elements in biological substances, drugs, pharmaceuticals, and related materials, fertilizers and feedstuffs, fine chemicals, food and food additives, fuels, glass and ceramic materials, insecticides and disinfectants, lubricants, metals and alloys, minerals and ores, paints, pigments and related substances, plastics and resinous materials, fuels, dusts, waters, and toxicants.

The method is extremely sensitive for detecting and measuring many chemical elements that occur in traces so slight that they cannot be determined by other chemical and physical testing processes. The method can be more specific than other techniques,

since elements to be tested, when irradiated, produce artificially radioactive isotopes that have their own characteristics as to modes of "decay" and types of radiation. The characteristics are never exactly duplicated in any other radio-isotopes produced.

The possibility of contamination that might interfere with testing, often encountered in conventional analyses, is negligible in neutron-activation analysis. It exists only when the material irradiated contains large amounts of elements that strongly absorb neutrons.

The new analysis method permits the examination of larger samples than the amounts usually used in conventional analyses.

The activation analysis group of the laboratory's analytical chemistry division, which has done much of the work of developing the technique, is conducting the analytical operations of the service, under the supervision of George W. Leddicotte.

Reactor-Produced Polonium

► REACTOR-PRODUCED radioactive polonium 210 may now be purchased at AEC's Oak Ridge National Laboratory for research activities.

Polonium is the first reactor-produced radioisotope to be sold which emits alpha particles. It can be used also as a source of high energy neutrons.

Polonium is needed by research groups for physical and biological investigations. It may be used also in oil well logging and for ionization sources.

The element could be used in lu-

minous phosphors, static elimination devices, and for other industrial purposes, but it is not available at present in the quantities required for such uses.

Polonium is furnished in two forms. When it is to be used as a neutron source, the polonium is mixed with beryllium and enclosed in a cylinder of nickel, about $\frac{3}{4}$ -inch in diameter. As an alpha source, the polonium is plated on a strip of platinum.

Polonium 210 produced in a reactor by neutron bombardment of bismuth is of higher purity than polonium derived from the radioactive decay of radium.

Operated for the AEC by Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corp., Oak Ridge National Laboratory is the site of the X-10 graphite-uranium reactor, or pile, in which most commercially available radioactive isotopes are produced. ORNL also produces and ships stable isotopes to licensed purchasers.

More than 35,000 shipments have been made since August 2, 1946, to users in 46 states and 33 foreign countries. Several thousand additional shipments were made from other sources, such as Brookhaven National Laboratory, Argonne National Laboratory and commercial processing concerns.

The demand for isotopes, distributed under a pricing system intended to cover production costs, has risen at a steady rate each year. No indication of leveling off is apparent in year-to-year figures on shipments. Shipments for fiscal year 1952 totaled some 9,000—about 25 per cent of shipments in the entire six years of the program.

The medical field, using isotopes in research and therapy, has taken some 13,000 shipments in six years, more than twice the number received by isotope users in the field of animal physiology, the second greatest field of isotope usage.

Next, in order of number of shipments: physics and chemistry, general research and development, industrial research, plant physiology, and miscellaneous, including commercial processors who resell the materials they buy.

The single largest selling isotope is iodine-131, with more than 10,000 shipments in six years, followed by phosphorus-32, with about 8,000 shipments.

In terms of radioactivity shipped, radioactive cobalt-60 has led the field with approximately 2,200 curies. Iodine-131 followed with about 1,200 curies. A curie is an amount of radioactive material which disintegrates at the rate of 37 billion atoms per second.

Atoms For Point 4

► FIRST USE of stationary atomic power plants might well be in the Point Four program.

This was suggested by Atomic Energy Commissioner T. Keith Glennan, speaking at a meeting of the American Society for Engineering Education at Dartmouth College.

An increasing demand for stationary nuclear power, Mr. Glennan said, will naturally arise first where present costs for electrical energy are high and this suggests that such a program may have an important place in any future Point Four programs.

Mr. Glennan said there are only a

few skeptics left in the field of mobile reactors for naval use and predicted a "firm demand" for conversion to naval propulsion under atomic power. Aircraft, however, is a job of almost unbelievable difficulty, but success there will also be achieved.

Mr. Glennan pointed out that future developments in atomic energy will call for an increasing number of scientists and engineers in the coming years and he urged educators to turn out an increasing number of well-trained, well-balanced graduates in these fields.

Electricity From Radiation

► ELECTRICITY is generated directly from atomic energy. This was revealed when a patent was granted for a "method and means for generating electrical energy from a radioactive source."

The patent was granted Dr. Ernest G. Linder, Princeton, N. J., a research physicist with the Radio Corporation of America, and assigned to RCA. Its number is 2,598,925.

The conventional method of atomic power production would be to construct a reactor which generates electrical energy by first using the heat from an atomic pile to make steam and then using the steam to operate a turbine. Dr. Linder's method generates electrical energy directly from atomic energy without the intermediate steps.

Dr. Linder's patent includes a high voltage direct current generator, an alternating current generator, a charged particle gun and a beam type alternating current generator.

The d.c. generator has a radioactive source, which can produce either al-

pha or beta rays. This is surrounded by a spherical highly evacuated conductive collector with a terminal for the radioactive source. The source might be radioactive phosphorus or polonium. Beta rays traveling between the source terminal and the collector electrode charge the collector electrode negatively.

"If a load is connected between the collector electrode and the source terminal," the patent says, "a current will flow through the load."

Thus the radioactive energy emitted in the beta rays may be employed directly in its original electrical form to provide electrical energy. The amperage is, however, very low.

Materials which produce beta rays do so in energies from almost zero to three million electron volts. And alpha ray emitters go up to ten million electron volts, the inventor points out. The generator can also use alpha particles, in which case the situation is reversed.

The alternating current generator is similar to the direct current generator, according to the patent. The beam type a.c. generator makes use of focusing electrodes.

X-Rayed Food Dangerous

► BE ON GUARD against foods that have been sterilized with X-rays, such as fatty meats, milk, butter, salad oils, certain grains and seeds.

So warns Dr. James F. Mead, chief of the biochemistry division of the Atomic Energy Project at the University of California at Los Angeles School of Medicine.

Research by Dr. Mead and his associates has shown that X-irradiation

has a damaging effect on the fatty acids found in many food substances. A chain of free radicals is released when such food is irradiated, thus destroying not only essential fatty acids and vitamins, but acting on other substances present to produce poisonous peroxides.

Safe Shelter

► THE ARMY's Chemical Corps is now emphasizing development of equipment to make any reasonably air-tight building or shelter safe against poison gas, germs or radiological agents spread through air. This type of "collective protection" is needed because protective clothing and masks against all three possible agents are too bulky and uncomfortable to be worn for long periods.

"Needed is a "chemical nose" which will smell out and identify as many different types of poison gases as possible and, by connection to a mechanical brain with "electronic vocal chords," announce its findings.

Fear Indicator

► WITH SUCH housewifely supplies as curtain material and a damp salt indicator chemical, Lt. Robert A. McCleary of the Air Force School of Aviation Medicine, San Antonio, Tex., has devised a test to show how much real fear the average person, particularly the average soldier, feels when about to meet the atom bomb face to face.

The curtain material, marquisette, was made into bags to hold the dampness indicator, cobalt chloride crystals used in summer-time salt cellar covers. The thousand soldiers who took part in the latest A-bomb test in Nevada this year held these bags in their hands while awaiting the explosion.

The crystals were blue at the start. They turned to light blue, lavender and finally a bright "sunset rose," as they absorbed moisture from the palms of the hands.

Perspiration in the palm, as distinguished from sweating due to heat, is considered by psychologists a good indicator of emotional response. Other methods have been used to measure this. But electronic gear, dipping the hands in solutions and so on are not practical for tests of troops in the field. So Lt. McCleary devised the curtain bags of dampness indicator to give a fairly accurate mass record of emotional response.

The bags contain a weight of crystals carefully measured to make a complete change of color with one gram, or about 20 drops, of moisture. The various shades are compared with six well-defined tints on a set of color standards.

Air Locks Protect

➤ **AIR LOCKS** which form a part of the ventilation system currently being used in some atomic plants to protect workers from radiation and toxic hazards are described to the American Society of Mechanical Engineers by W. W. McIntosh of the General Electric Co.

Different zones in atomic plants have been separated structurally and kept at different air pressures so that ventilating air always flows from the less to the more hazardous zone when doors to those zones are opened. The air then is exhausted near the place in the room where the hazard is the greatest.

A second system uses powerful exhaust fans to draw fresh air into the plant at the least hazardous spots and

to pull it on through the plant to more dangerous spots. Finally it is exhausted at the most hazardous spot.

Before exhaust gases are discharged into the outside air, waste particles are filtered out and then the gas itself is scrubbed. Final discharge point of the gas may be from a stack 200 or more feet in height to obtain a further safety margin.

Zr and Hf \$15 Lb.

➤ **ZIRCONIUM** and hafnium metal will be produced under an AEC contract with the Carborundum Metals Co., a subsidiary of the Carborundum Company of Niagara Falls, N. Y. Approximately 150,000 pounds of zirconium and hafnium sponge metal each year for a period of five years will be provided at a unit price of less than \$15 per pound.

AEC's present requirements for zirconium and hafnium are being met by pilot plant production in government-owned facilities at Oak Ridge, Tenn., where the raw material is purified, and Albany, Ore., where purified zirconium oxide is converted into metal. The Carborundum contract encourages private enterprise, using private capital, to take over portions of AEC work which can be handled on a conventional business basis.

Zirconium is a metal useful in the construction of nuclear reactors. Its desirable properties are its corrosion resistance, ductility, strength and low rate of absorption of neutrons. It had not been produced on a large scale prior to the time the Government began pilot plant operations about two years ago.

The present process for production of zirconium sponge was developed and placed in pilot plant production

by the Bureau of Mines at its Northwest Electro Developmental Laboratory at Albany, Ore. The Bureau of Mines was encouraged in this work by the Navy's Bureau of Ships, and by the AEC because of their long-range interests in zirconium. The mutual co-operation among these three Government agencies has contributed substantially to the success of the work in Oregon. Both zirconium and hafnium are produced from zircon sands presently obtained from the beaches of Florida.

A-Bombs Dirty "Clock"

► ATOMIC BOMB explosions this year in Nevada are interfering with the time clock of Dr. W. F. Libby, University of Chicago physicist. His time clock is a method of measuring the age of anything that lived up to 25,000 years ago by the strength of the radioactive carbon contained in the ancient materials.

But the atom bomb explosions have been getting the radioactive carbon in his specimens "dirty." The blasts have thrown enough radioactive "dirt" into the air so that some of it settles on the wood samples he collected from old Egyptian tombs for his experiments.

The "hot" dust boosts the overall radioactivity of samples and makes them appear younger than they are.

Small traces of radioactive carbon of atomic weight 14 are in the air at all times. It is believed to be formed when nitrogen atoms are bombarded by cosmic rays at high altitudes. Ordinary carbon has an atomic weight of 12.

The radioactive carbon is taken into living things just as ordinary carbon is. But like all radioactive elements, it

disintegrates at a fixed rate. By measuring the radioactivity left in the sample, Dr. Libby has been able to date the specimen.

Uranium Purifies Rare Gases

► THE A-BOMB element, uranium, has a new peacetime use. Rare gases can be purified by using a uranium powder more effectively and conveniently than by any other method, two scientists at Johns Hopkins University have reported to the Optical Society of America.

Drs. G. H. Dieke and H. M. Crosswhite found uranium hydride can be used to eliminate impurities released from electrodes or walls of vessels such as rare-gas discharge tubes. Such impurities often make it impossible to obtain significant measurements.

Uranium hydride is heated to about 400 degrees Centigrade to drive off the hydrogen. Then the rare gas is admitted. Since the uranium reacts with practically every gas except rare ones like helium, argon, neon, etc., the impurities are absorbed.

A sealed-off iron hollow cathode discharge tube previously became contaminated in two days. But, after adding activated uranium, the tube has remained pure for more than five months of constant use.

A-Facts Not Told

► PRESIDENT JAMES B. CONANT of Harvard has said "the general public might just as well stop reading anything in the papers about atomic energy or atomic bombs. By the nature of the case it is almost certain to be misleading."

Dr. Conant said in a lecture at New York's Columbia University that the

future of atomic energy has become a matter of pride for politicians and that the public is largely informed about atomic energy by politicians only partially aware of their own distortion of the facts and unconscious of the degree of uncertainty of the facts.

"At times half truths and necessarily ambiguous reports by responsible officials 'leak' into newspaper col-

umns," Dr. Conant said. "These are the methods by which the public is informed of the progress of applied nuclear physics. I can underline what I have been saying by making one bold statement based on 12 years of experience behind the veil of secrecy: It is impossible today or in the foreseeable future to have a frank, rational, searching discussion of the industrial uses of atomic energy."

Amorphous Selenium For Infra-Red

➤ AMORPHOUS non-crystalline selenium has desirable optical qualities in the infra-red spectrum of light.

H. A. Gebbie and C. G. Cannon of the physics research laboratories at the University of Reading, England, have reported that lenses made of this element can have short focal lengths, yet have large radii of curvature because the material sharply bends light rays passing through it. This high refractive index, as it is called, allows the

lenses to minimize focusing flaws characteristic of many lenses.

Lenses having aperture ratios of $f/1$ (the diameter of the lens being about equal to its focal length) might be used as microscope condensers, and objective lenses for the spectroscopy of small specimens. They also might be used as an alternative to ellipsoidal condensing mirrors in spectrometers.

Lenses made of the material can be optically polished, but quality surfaces are obtained more easily by molding.

Light Helium Isotope More Ordinary

➤ A RARE and lighter-weight helium is not so strange, even though it is "twin" to one of the world's strangest liquids, ordinary helium liquefied. Ever since the discovery of the extraordinary superfluidity of ordinary helium 4, when cooled to near absolute zero temperature, scientists have wondered whether the other variety or isotope of helium, weight 3, is also a queer liquid.

A team of scientists from the Argonne National Laboratory, Chicago, have manufactured sufficient quantities of pure helium 3 by nuclear transformations to allow the investigations.

The theory has been that the lighter helium isotope follows one kind of theoretical statistics, the Fermi-Dirac formulation, while helium 4 follows the Bose-Einstein statistics, which explains the phenomenon of flowing where it would seem impossible for any normal liquid to go.

Drs. Darrell E. Osborne, Bernard M. Abraham and Bernard Weinstock found that liquid helium 3 acted normally, but it does have the remarkable property of remaining liquid when cooled to absolute zero, unless a high pressure is applied, just as is the case with ordinary helium.

For The Home Lab:

Fascinating Phosphorus

by BURTON L. HAWK

➤ PHOSPHORUS is one of the most interesting of all the elements. Its peculiar property of glowing in the dark places it in a special and rare category. For some unexplained reason, man has always been intrigued by any substance with phosphorescent properties.

The history of phosphorus is no less interesting than the element itself. It was first prepared in 1669 by a German alchemist, Hennig Brand. Brand, like every other alchemist of his day, was searching for the elusive philosopher's stone. We can never tell you what gave him the idea that this magic stone would be found in human urine, but, nevertheless, he carried on a series of elaborate experiments with urine. After much experimentation, he obtained a yellowish waxy substance by distilling a residue from the urine. We can imagine how thrilled he must have been when he noticed that this strange substance glowed in the dark!

Brand kept the details of the preparation of this strange substance secret, but the news soon leaked out. He then sold his formula to other chemists, who also made the element in secret. It was not until 1737 that the method of isolating phosphorus was made known to the world in general. It was soon discovered that the element could be obtained from bones, and the unpleasant method of obtaining it from urine could be abandoned.

It is truly remarkable that Brand could prepare phosphorus with the very limited equipment and knowledge then available. Even today with all of our modern equipment, phosphorus is not isolated with ease.

Words of Caution:

We do not recommend these experiments for the careless or the inexperienced. Phosphorus may be fascinating, but it is also intensely poisonous. It should *never* be allowed to touch the skin, as it causes painful burns which are extremely difficult to heal. Always handle with forceps and keep it under water when not in use. Do not inhale its vapors. You will note that phosphorus has a garlic-like odor. But do not "note" too strongly—these fumes are poisonous too.

Yellow Phosphorus

Phosphorus occurs in three allotropic forms: yellow, violet, and black. However, the two most common forms are yellow and red. There is a difference of opinion as to whether the red form is a separate allotropic modification. One of the latest theories is that red phosphorus is phosphorus only partially changed from the yellow to the violet form.

The phosphorus obtained by the reduction of phosphates is always the yellow variety. This is "regular" phosphorus and the other allotropic forms are prepared from it.

Place a piece of yellow phosphorus the size of a pea in a flask half filled with water. Apply gentle heat. The phosphorus quickly melts under the warm water. Now stopper the flask; shake, and cool under running water. The phosphorus separates into many small globules. You will find these small balls handy for experimenting.

Phosphorus combines readily with oxygen and ignites in the air at 30 degrees. Take a small piece and dry carefully with filter paper. Note the white fumes as the element starts to react. Place in a metal dish and heat very gently. Almost immediately it will ignite and burn with a bright yellow flame accompanied by dense white smoke (P_4O_6 and P_4O_{10}).

Spontaneous Combustion

Phosphorus is very soluble in carbon disulfide. Dissolve a piece about the size of a rice grain in 3 cc. of carbon disulfide. Dip a piece of filter paper in this solution (with forceps), and hold it suspended in the air. Nothing happens at first. But, wait. Suddenly the paper ignites with a flash of greenish flame. The filter paper is not consumed, but only partially charred.

If you want to write your initials in flames, you can do so by painting them on a large piece of filter paper with the phosphorus solution. Use a small paint brush for this purpose. Again hold the paper in mid air with forceps. Suddenly the outline of your initials will burst into flame.

And it Glows in the Dark!

Perhaps you would prefer your initials in luminous characters instead of flames. If so, paint your initials with the phosphorus solution as be-

fore, but on a white card instead of filter paper. Place the card in total blackness and observe the luminous writing.

Be very careful with the phosphorus solution, as it is highly inflammable. Dispose of it immediately after experimenting either by burning it or washing it down the drain with large quantities of water.

Place a small piece of phosphorus in a flask and cover with water. Attach a one-hole stopper containing a small glass tube extending about 3 inches above the flask. Boil the water in a dark room. If the room is dark enough, you will be able to observe the rather eerie effect of luminous steam.

Red Phosphorus

Red phosphorus is so unlike yellow phosphorus, it is difficult to realize both forms are the same element. The red type is an amorphous powder. It will not ignite spontaneously. It will not dissolve in carbon disulfide. It will not glow in the dark. It has no odor and is not poisonous. It ignites only when heated to about 240 degrees. You can prove this if you wish by placing some of the powder in a metal pan and heating. Compare the amount of heat you must apply with that applied to yellow phosphorus in order to ignite the powder.

Red phosphorus is prepared by heating yellow phosphorus in the absence of air. The action may be catalyzed by a trace of iodine.

Violet phosphorus is prepared by dissolving phosphorus in molten lead and then allowing it to separate by crystallization.

Black phosphorus is made by sul-

jecting yellow or red phosphorus to 1000 atmospheres of pressure at a high temperature.

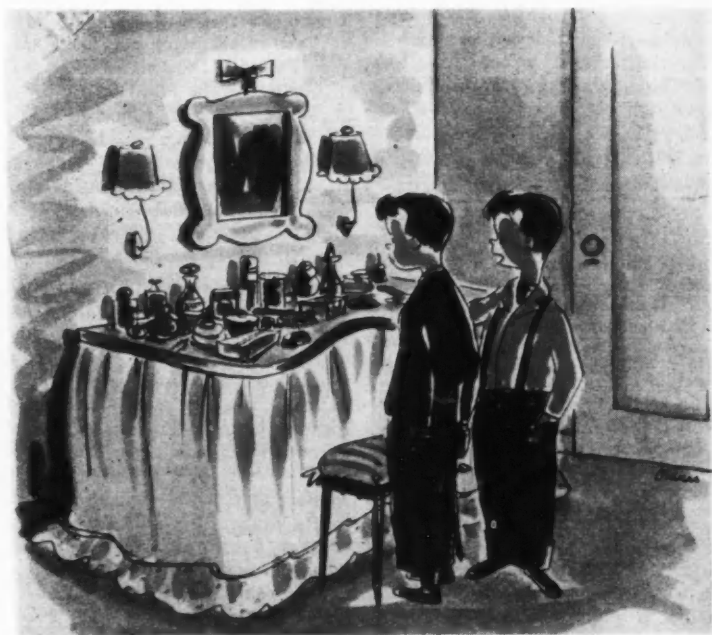
The yellow phosphorus can be prepared from any other form by distillation. When heated strongly enough, all forms of phosphorus vaporize and this vapor always condenses to form the yellow variety.

We suggest that you do not attempt to prepare the various allotropic modi-

fications of phosphorus. These reactions are a little too dangerous for the home laboratory.

When you are through experimenting, be doubly sure that you have thoroughly disposed of all phosphorus particles or solutions. Ignite any stray particles and thoroughly wash all equipment.

Remember — phosphorus is like a pretty girl: always interesting, but sometimes dangerous!



—Kate Osann in Collier's

➤ *This is my mother's chemistry set.*

**Sun Never Sets on Corn
Or Its Many Chemical Products**

Corn and Its Chemical Products

Excerpts from the address by Dr. E. W. Reid, President, Corn Products Refining Company, New York, accepting the 1951 medal of the American Section of the Society of Chemical Industry, reprinted from THE CHEMIST.

► THE RELATIONSHIP of chemistry, agriculture, and particularly the relation of the latter to modern civilization is little realized, and by agriculture, I refer in particular to the cereals. An ancient philosopher once said that "no civilization worthy of the name has ever been founded on any other agricultural basis than cereals." . . .

Of the cereals, corn, or, as it is known in many parts of the world, Indian maize, is by far the most important. Corn is strictly a product of the Americas and was entirely unknown in any other part of the world before Columbus made his discovery. Later he wrote of seeing fields of Haitian corn eighteen miles long. The importance of this grain in the development and growth of our country is little realized, nor is it generally known that due to this grain, the Americas are the only countries of the world that have never had a major famine. The origin of corn is unknown, although the oldest record points to Peru. It has never been found in the wild state, the evidence suggesting that one of its original parents is extinct. Unlike other grains, corn is not "self-grown" and it has, so far as is known today, always been

dependent upon man for its existence. Corn is grown in every state in the Union and in every country in the Western hemisphere.

The sun never sets on growing corn. The world acreage, approximately 210 million, ranges from 58° north latitude in Canada and Russia to 40° south latitude in the southern hemisphere. It is grown below sea level in the Caspian Plain, at altitudes of more than 12,000 feet in the Peruvian Andes, in regions of less than 10-inches annual rainfall in the semi-arid plains of Russia, in areas of more than 200-inches in the tropics of Hindustan, in short growing periods in the northern U. S. and Canada, and in the perpetual summer of tropical Colombia.

Corn shaped the destiny of the new world and is still one of the important factors economically for our prominence among nations. This cereal which has made history is not only a native grain, but also domestically consumed. Approximately 85 per cent of our production never leaves the farm. When the existence of the Massachusetts and Jamestown settlements hung in precarious balance in the first hard winter of their settlement, it was corn which they obtained from the Indians that saved them. The first settlers that crossed the Alleghanies soon sent back word of the richness of the soil in the Mississippi River basin, tall tales of the growth of corn, of sleek cattle and fat hogs. In 1812, because a major par-

our population was on the Atlantic seaboard, they were dependent upon the importation of most of their food. When the British Blockade cut off this importation, famine was only averted in these states by the food supplied from the then little-known Middle West. This started a great migration westward, the beginning of a new era in the history of this country.

The Milling of Corn

There are two methods that are used in the milling of corn, the dry and the wet. Compared with most chemical processes, the wet milling of corn and the production of starches, dextrines, and sugar is a simple process. In brief, it consists of steeping the shelled corn for about one and a half days in water containing a small quantity of sulfur dioxide. The steeping loosens the hulls and softens the gluten, while the sulfur dioxide prevents fermentation. The steepwater absorbs most of the mineral matter, soluble proteins, and carbohydrate. After special treatment, the steepwater is utilized in the production of antibiotics. The remaining starch, protein, fiber, and germs are separated by mechanical means and utilized to produce a number of industrial products.

Industry utilizes the products of this grain in several hundred applications. The diversity of uses ranges from various food products to core binders, from baby feeding to the separation of ores, from textiles and paper to oil well drilling. In fact, almost every facet of modern industry and modern living requires the products of the wet milling industry.

Chemical Products from Corn

The development of chemical products from starch, glucose, and proteins has received considerable publicity, but up to the present time has not resulted in any sizable development. The alcohol-soluble portion of the protein of corn, which is known as zein, is being utilized to a limited extent in the production of a textile fiber known as Vicara. This fiber has most of the attributes of wool, but is not affected by molds or moths. It has certain moisture absorption properties that can be regulated to advantage with other synthetic or natural fibers. Zein is also used as a greaseproof coating, in high-speed inks, certain types of paper coatings, as a cork binder and for a wide variety of other uses.

The hull or bran of practically all cereals contains phytates, usually in the form of a metallic salt, such as magnesium, calcium, potassium, etc. These phytates appear in the steepwater of corn and can be isolated and used for the production of various metallic phytates, phytic acid, and on hydrolysis, inositol. Inositol is one of the vitamins, but its exact role in nutrition is not fully established. It apparently has some lipotropic function, and also is believed to have a definite benefit in certain circulatory diseases. Since it has six hydroxyl groups, it may be reacted to produce esters, ethers, and amines. The nitrated form is used to control high blood pressure. It can be oxidized to inosose, tetrahydroxyquinone, rhodizonic acid, triquinoyl, and croconic acid.

Starch Products

Starch can be reacted with a large number of other chemical products and in various ways to produce such

compounds as carboxymethyl starch and other carboxyalkyl starches. The lower carboxyalkyl starches are, in the main, cold water soluble products of high viscosity and stability. They can be used as food thickening agents, emulsion, suspension and stabilizing agents, paint binding, printing dye thickeners, textile and paper sizes. If the starch is reacted with highly unsaturated groups such as allyl or vinyl, resinous and plastic materials can be produced. Other products, such as the esters and ethers of starch have been produced in the laboratories, but up to the present time have not found wide industrial use.

Dextrose, produced by the hydrolysis of starch in the presence of an acid, can be polymerized or oxidized, and therefore offers a rather wide and potentially fertile field in the development of chemicals. A number of chemical compounds can be produced by the oxidation of dextrose, among which is glucuronic acid that is being tested clinically for use in arthritis and as a general detoxifying agent. Various organic acids can be produced from dextrose, such as saccharic, tartaric, levulinic, gluconic, citric, and such products as hydroxymethylfurfural, which is normally considered an intermediate in the formation of levulinic acid. Sorbitol and mannitol are produced from dextrose by electrolytic or catalytic reduction. Sorbitol is an intermediate in the production of ascorbic acid or vitamin C, and is also used as a humectant, plasticizer, and in the preparation of esters and resins.

Mannitol hexanitrate is utilized to some extent in the explosives field.

Small amounts of boron compounds added to leaded gasoline reduce octane requirements for knock-free operation.

The oxidation of dextrose in strong alkali solution, under proper conditions, will produce d-arabonic acid which, by heating with aqueous pyridine, will yield d-ribonic acid which is the base for the synthesis of riboflavin.

The oil of corn, obtained from the germ, is not only used as a food, but is a source of raw material for the production of a large and diversified group of carbon-rich chemicals. In addition to the glycerides of the fatty acids, it is a source of other products such as sterols, tocopherols and carotinoid pigments. The sulfated and sulfonated oil has use as an emulsifier and textile lubricant. The fatty acids may be used in the synthesis of various products useful in the preparation of water-proofing agents, emulsifiers, detergents, flotation agents, insecticides and plasticizers.

The tocopherols, vitamin E, can be separated and purified. Several sterols, chiefly sitosterols, may be separated and utilized in the preparation of hormones.

A rich source of carotinoids is the xanthophyll oil, a highly pigmented product obtained from the gluten of yellow corn. This product is used in poultry feeds to increase the skin pigmentation of the fowl and to improve the color of the yolk of the eggs.

The utilization of agricultural products as raw materials for the synthesis of new chemical products offers a new challenging field. It is a field of science that requires a large amount of fundamental research, as well as industrial development and application.

Limestone Glow Measures Time and Radiation

Thermoluminescence Tells Rocks' Age

FOR MANY years it has been known that fragments of limestone when heated to temperatures below that of 400°C in a totally dark room gave off light of varying intensity. In a paper presented before the 64th annual meeting of the Geological Society of America, Dr. Edward J. Zeller of the University of Wisconsin, reported that recently this phenomenon, known technically as "thermoluminescence," has found application in the science of geology in age determinations of limestone strata throughout the geologic column. Direct observation indicated that the amount of light given off by the limestone varied in direct proportion to the geologic age of the sample. Rocks of younger geologic age (Tertiary and Mesozoic) were found to be only slightly thermoluminescent, but older rocks (Paleozoic) glowed brightly.

Limestones and other thermoluminescent substances, it was found, could be reactivated by high-energy radiations such as gamma rays after their natural thermoluminescence had been lost through the initial heating of the sample in the laboratory. This reactivation was thought to occur through the ability of these radiations to free electrons within the crystal lattice. The free electrons then became trapped in imperfections within the crystal lattice where they would remain until the crystal was heated enough to give the electrons sufficient energy to es-

cape from their traps. Additional, more quantitative data tended to confirm the original observations and the basic theory that thermoluminescence is proportional to the product of time and radiation was developed.

If the theory were correct, Dr. Zeller points out, it should be readily possible to determine the geologic ages of limestones, providing that the thermoluminescence could be accurately measured and the amount of radiation received by the lattice per unit time could be determined. Limestone samples whose ages had been previously determined through the use of fossils were used as a test of the accuracy of the method. Each sample was ground and sieved to insure uniform size of particles. The samples were then irradiated in a 5 Curie cobalt 60 gamma ray source. Insoluble residue analyses were run to determine the per cent of calcium carbonate and impurities in the sample and the relative transparencies of the samples were determined. Finally, a glow curve was run which recorded the intensity of the light emitted by the sample as it was heated at a uniform rate to 400°C . The data thus obtained, when plotted in three different manners, agreed within experimental error with the ages of the known material.

Dr. Zeller says that the determination of geologic time by means of the previously-discovered lead-uranium method has always been handicapped

by the comparative scarcity of material, the difficulty of analysis, and the frequent inability to correlate the results directly with stratigraphic and structural events. If limestones or calcite veins can be dated accurately, much valuable stratigraphic and paleontologic information can be ob-

tained. The thermoluminescence method of age determination may find its greatest practical use in dating geologic events. Other highly thermoluminescent minerals such as dolomite, quartz, fluorite, and the feldspars may be adaptable to this method of the determination of geologic age.

Flash of Genius Unnecessary for Invention

► IT NO LONGER takes a "flash of creative genius" to come up with an invention which can be patented.

Congress has passed and President Truman signed a basic revision and codification of the mass of laws having to do with patents which have been passed since the first codification in 1870.

The new law also clarifies and reverses several court decisions. One of these decisions, made in 1941 by Justice William O. Douglas, declared that an invention had to be the result of a "flash of creative genius and not merely the result of the skill of the calling," to be worthy of a patent. The new law says that it does not matter how the invention was made, it is immaterial whether it resulted from long toil and experimentation or from a flash of genius.

Another section makes it easier to prove contributory infringement of a patent. Under the new law, someone who induces infringement can be guilty of contributory infringement as well as the person who actually contributes to the infringement.

Previously the courts had said that contributory infringement was illegal

but that if a patent holder tried to go into court about it, he was misusing his patent. The new law does away with this paradoxical situation.

For the first time, it has been spelled out that the courts shall presume that a patent is valid once granted by the patent office. Previously, in some courts, the inventor had to prove that he had a right to his patent.

The law is the result of a co-operative effort of many interested in patents. Scientists, inventors, corporations, patent lawyers and government officials got together to bring order out of what they felt was the chaos of patent law.

The first real patent law was passed in 1836, although a patent office had been set up at the behest of Thomas Jefferson in 1790. The laws were revised in 1870. Since then, new laws relating to particular cases, decisions by the courts of the land and opinion as to the meanings of the law have grown into a state of some confusion. The House Judiciary Committee which held hearings on the new law feels the basic principles on which patents are granted have been codified for the first time.

Summary of Inventions Given U. S. Patents

Chemical Progress in Patents

Patents may be ordered by number from the Commissioner of Patents, Washington 25, D. C., at 25 cents a copy. Remittances should be sent in coin, money order, U. S. Patent Office coupons, not stamps.

Half Life Measurement

► MEASURING the half-life of radioactive materials when the half life is as short as one-thousandth of a second can be accurately done with a new method which has received a patent.

Clyde E. Wiegand, Oakland, Calif., is the inventor and he has assigned his patent, number 2,590,057, to the Atomic Energy Commission.

Previous methods, such as impressing the radioactive pulse of the material on an oscilloscope, were insufficient for the short-lived materials, the inventor says. The present method feeds the pulses from a radioactive detector through a discriminator and a height-varying circuit to a multichannel differential pulse discriminator.

Cycloalkane Oxidation

► FRANCIS T. WADSWORTH, Dickinson, Tex., received patent number 2,589,648 for a new cycloalkane oxidation process. The patent was assigned to the Pan American Refining Corporation, Texas City.

A reaction solvent is necessary in the catalytic process, Mr. Wadsworth says. The present process comprises the oxidation of a solution of cyclohexane in acetone.

Rice Processing

► DANIEL S. FERNANDES, Paramaribo, Dutch West Indies, has received patent 2,592,407, for a new method of processing rice so that the vitamins are preserved in the finished product. Vitamins are originally present in the husk, which is removed during processing. In this invention, the vitamins permeate the rice kernels when, throughout the processing, the surfaces of the individual rice grains are kept uniformly accessible to the treatment.

Guards Silver From Tarnish

► A METHOD and material for keeping silverware from tarnishing while it is not in use received patent number 2,590,094.

The material can be formed into bags, pouches or rolls, or it can be used as lining for chests and boxes in which silverware is stored. The method of manufacturing and the fabric were invented by Birger Egeberg and Jean P. Phaneuf, both of Meriden, Conn., and Malcolm A. Orr of Southington, Conn. Their patent has been assigned to the International Silver Co., Meriden, Conn.

Under ordinary conditions of storage, silverware tarnishes because sulfide and other gases react with the silver to produce silver sulfide, which is tarnish. By incorporating silver strands in the material, the inventors claim the metal will react with the tarnishing gases and allow only "clean

air" to reach the silverware inside the fabric.

The silver strand, a fine wire, is wrapped around a regular piece of yarn woven into the fabric. Because the tarnish preventive is not a chemical, the material can be washed without losing its effectiveness. And because the metallic strands are buried in the cloth, the fabric can be dyed satisfactorily to desired colors, they said.

Liquid Oxygen Method

► PETER LEONIDOVITCH KAPITZA, Soviet Union physicist, has received U. S. patent number 2,593,763, for a process which is claimed to be "extremely efficient in refrigerating plants operating at extremely low temperatures for producing liquid oxygen and similar products."

Application for the patent was first made in Russia May 15, 1945, and in this country Feb. 20, 1946. Little has been heard of Kapitza in the past few years. Rumors have had him in Siberia for failing to leave his low temperature work for research on the A-bomb, or in a relatively obscure laboratory in Moscow.

Kapitza first made his name as a scientist at Cambridge University in England, where he delved into the low temperatures—300 or so degrees below zero, Fahrenheit. However, in 1935, when he went back for a visit to his native Russia, the Soviet officials picked up his passport and "detained" him in Moscow.

His present patent calls for using centrifugal force in the distillation of gases and liquid gases. It is one of several patents granted the Soviet scien-

tist, one of them almost exactly a year ago.

The National Bureau of Standards has been working extensively on separation and distillation processes in the hope that some of them may be applied to the separation of heavy hydrogen from ordinary hydrogen, a process necessary in the manufacture of the hydrogen bomb. Indications are that our scientists have been successful in this endeavor. However, they do not believe that Kapitza's present invention could be successfully adapted to this purpose.

Chemically Heated Knife

► AN INVENTION pertaining to oil wells was developed by Bert A. Cabaniss of Fa'furrias, Tex., assigned to the Sperry-Sun Well Surveying Co., of Philadelphia, and was granted patent 2,590,931.

The invention is a chemically heated knife which is lowered into drill holes to scrape away paraffin deposits on the inner walls of well tubings. Crude oil sometimes becomes chilled as it flows through the well tubing and deposits over a period of time enough paraffin to reduce well production appreciably.

Mr. Cabaniss' paraffin cutter consists of a cylinder pointed on one end. Knife blades are staggered around the outer shank farther up the cylinder. When paraffin becomes too thick for the instrument to cut, the assembly is pulled up in the hole a bit, then allowed to fall again. The jolt causes sulfuric acid to flow into a chamber containing sodium hydroxide. That chemical combination generates heat which melts most of the paraffin and allows the knife blades to scrape away the remainder.

Coal Gasified Underground

► AN IMPROVED method of turning coal into gas without removing the coal from the ground has been invented by Louis L. Newman, Washington, D. C., and Wilburn C. Schroeder, Clinton, Md. They have received patent number 2,593,477 for their invention and have assigned their patent to the Department of the Interior.

Drawbacks in previous methods of burning coal underground to extract the gases, according to the patent, were that the coal was not always entirely consumed and that the gases themselves sometimes caught fire before they could be brought above ground.

The inventors claim they get around these two difficulties by drilling many holes into the coal seam, the holes being in rows. The air, or other oxygen-containing gas needed to support the burning of the coal, is fed into the coal seam through one row of holes, while the resulting gases are drawn off in the second row.

Other smaller holes are drilled in between the rows. When the gases catch fire, non-burning sealing materials can be pumped into these intermediate holes to seal the gases off from the oxygen and the fire.

Insulin Production Doubled

► A METHOD for doubling the production of insulin, which is extracted from animal pancreas glands, has been invented by Loyal C. Maxwell, Chicago, and William P. Hinkel, Brookfield, Ill.

Since the amount of insulin available to diabetic patients is critical, the matter of yield is one of great impor-

tance," the inventors say in their patent which received number 2,595,278. It was assigned to Armour and Company, one of the largest producers of the vital medicine.

The substantial increase in insulin production is achieved by substituting phosphoric acid in the distillation process for the hydrochloric and sulphuric acids now used in commercial production.

Hydrochloric acid causes a swelling and gelation of pancreatic tissue, making it difficult to work with, the inventors say. Sulphuric acid is less effective in the extraction of insulin and thus a stronger concentration of it must be used. This brings about a serious loss at later stages, which does not occur under the new method.

Artificial Snow

► FOR A METHOD of producing artificial snow, Herbert E. Britt has received patent number 2,594,725. He is from Los Angeles, where they seldom get the natural kind. The snow is made of a liquid alkali and a liquid acid capable of forming a gel. It can be sprayed or poured.

Sun Heating Homes

► A SOLAR heating panel for using the radiant energy of the sun directly to heat houses has been invented by Dr. Maria Telkes, of the Massachusetts Institute of Technology. She received patent number 2,595,905 for her invention.

The outside of the panel, which is placed in the wall of a building, is made of a material which will absorb great amounts of radiant energy. This is backed up by a dead air space which prevents heat from getting out once it

has gone in. Then there is a hollow metallic cell. The outer wall of the cell also absorbs heat from the sun. The inner wall is the wall of the room inside the house.

Inside the cell is a solution of Glauber's salt which has a melting point of 90 degrees Fahrenheit and a relatively high heat fusion point. When the sun heats the Glauber's salt to 90 degrees, the solution begins to store heat, rather than transmitting it. Once the sun goes down, as the Glauber's salt cools off and begins to solidify, it gives off heat, thus keeping the house warm in the night.

Liquid Coal

➤ A METHOD for making a relatively heavy crude oil out of coal while it is still underground and in the seam and then pumping it up for further refining into suitable motor fuels has been invented by Ernest F. Pevero, Beacon, and George B. Arnold, Glenham, N. Y., and assigned to the Texas Company. It received patent number 2,595,979.

A well hole is drilled into the coal seam. Through this a hydrogenating agent is introduced and the resulting oil drawn off. Heat to set off the process may be supplied by an electric heater, the inventors say.

This process, they claim, cuts out two costly steps in the preparation of coal for hydrogenation, first actual mining of the coal, and then, the fine grinding of the coal to obtain a powder.

Germanium Pellets

➤ A METHOD for producing pellets of germanium for use in asymmetrically

conductive devices has been invented by William C. Dunlap, Jr., Schenectady, N. Y., and assigned to the General Electric Company. The invention received patent number 2,595,780. His method provides a shot tower device which enables a continuous gas pressure to be supplied across an ingot of germanium while it is being melted within a crucible. This pressure ejects the germanium in the form of droplets.

Anti-TB Chemical

➤ A PATENT for medicines and a veterinary feed containing the new anti-tuberculosis chemical, isonicotinic acid hydrazide, was issued by the U.S. Patent Office to Dr. Herman Herbert Fox of Passaic, N. J., and assigned by him to Hoffmann-LaRoche, Inc., of Nutley, N. J.

The patent is a "use" patent for compounds containing isonicotinic acid hydrazide as the active ingredient. The hydrazide chemical itself was made some 40 years ago and is not patentable.

Both Hoffmann-La Roche and E. R. Squibb and Sons had developed the active chemical, independently and simultaneously, as a possible antituberculosis drug. Promising results in trials on human patients with drugs from both firms were announced in February of this year. La Roche calls its preparation by the trade name, Rimifon, and Squibb calls its preparation Nydrasid.

The application for the patent issued to Dr. Fox was first filed on March 17, 1951, three months before the trials on patients were started. The patent application was refiled on March 7 of this year.

Book Condensations

Recorded in the pages of books are data and information that has had time to be arranged and summarized, the textual material which the student learns, the occasional biographical opus which gives science personality, and the gatherings together that some author and publisher believes will sell and perhaps be useful. **CHEMISTRY** keeps you current with books through this listing.

BIOCHEMICAL PREPARATIONS: Volume 2—Eric G. Ball, Ed.—Wiley, 109 p., illus., \$3.00. Practical instructions for making various biochemical preparations.

CHEMICAL ENGINEERING OPERATIONS: An Introduction to the Study of Chemical Plant—Frank Rumford—Chemical Publishing Co., 376 p., illus., \$7.50. A textbook describing the processes which are peculiar to chemical plant practice.

THE CHEMISTRY OF ORGANIC COMPOUNDS: A Year's Course in Organic Chemistry—James Bryant Conant and Albert Harold Blatt—Macmillan, 4th ed., 655 p., \$5.90. New material has been added to this edition, especially in biochemistry and industrial chemistry.

COLLEGE CHEMISTRY—Paul R. Frey—Prentice-Hall, 650 p., illus., \$7.95, text ed. \$5.95. College text with novel presentation—introducing the elements in an order opposite to that of the periodic table. Concepts are defined in the most modern terms.

A COURSE IN COLLEGE CHEMISTRY—V. R. Damerell—Macmillan, 587 p.,

illus., \$5.50. A text for beginning college students, particularly non-chemists such as home economics majors.

DDT AND NEWER PERSISTENT INSECTICIDES—T. F. West and G. A. Campbell—Chemical Publishing Co. 1st American edition, 632 p., illus., \$8.50. Telling of the physical and chemical properties and principal uses of the newest insecticides.

DU PONT, THE AUTOBIOGRAPHY OF AN AMERICAN ENTERPRISE: The Story of E. I. Du Pont de Nemours & Company Published in Commemoration of the 150th Anniversary of the Founding of the Company on July 19, 1802—E. I. Du Pont de Nemours & Company—Scribners, 138 p., illus., \$5.00. A beautiful record of what has happened to a great American company over a century and a half.

DYNAMIC ASPECTS OF BIOCHEMISTRY—Ernest Baldwin—Cambridge University Press, 2d ed., 544 p., \$5.00. A text intended to encourage dynamic habits of thought and prepared especially for those students who are not studying biochemistry in preparation for medicine.

EFFECTS OF ATOMIC RADIATIONS ON LIVING ORGANISMS: Twelfth Annual Biology Colloquium—Curt Stern, Leader—Oregon State Chapter of Phi Kappa Phi, 52 p., illus., paper, 75 cents. Informal discussion of an important modern problem. Includes reports on radiation genetics, radiation measurement, effects on plants, biochemical aspects of radiation injury and medical planning for atomic defense.

EXPERIMENTAL NUCLEONICS—Ernst Bleuler and George J. Goldsmith—*Rinehart*, 393 p., illus., \$6.50. A textbook for students of nuclear physics and those planning to perform tracer research, covering both chemical and physical aspects of the technique.

FIRST SYMPOSIUM ON CHEMICAL-BIOLOGICAL CORRELATION—Chemical-Biological Coordination Center—*National Academy of Sciences—National Research Council*, 415 p., \$4.00. Papers discussing the relationships between chemical structure and various biological actions and effects.

GLASS: A Handbook for Students and Technicians—J. Home Dickson, Ed.—*Chemical Publishing Co.*, 300 p., illus., \$6.00. A reference book on the structure, composition, manufacture and applications of one of our commonest materials.

GMELINS HANDBUCH DER ANORGANISCHEN CHEMIE—Herausgegeben Vom Gmelin—*Verlag Chemie* (Walter J. Johnson), 8th ed., illus., paper, System-Number 3, Part 2, Sauerstoff, 218 p., \$15.48; System-Number 27, Part A 4, Magnesium, 336 p., \$23.81; System-Number 17, Arsen, 475 p., \$33.33; System-Number 41, Titan, 481 p., \$27.20.

HARDNESS AND FLEXIBILITY OF NATURAL AND SYNTHETIC RESIN VARNISHES—Robert L. Feller—*Mellon Institute*, 2 p., paper, free upon request to publisher, 4400 Fifth Ave., Pittsburgh 13, Pa. Reprinted from *The Museum News*.

HARWELL: The British Atomic Energy Research Establishment 1946-1951—*Her Majesty's Stationery Office*, 128 p., illus., paper, approx. 84 cents. Official report of what the British are

doing in atomic research. A useful glossary and reading list are included.

HOW TO SOLVE GENERAL CHEMISTRY PROBLEMS—C. H. Sorum—*Prentice-Hall*, 157 p., paper, \$1.85. It has been the author's experience that students succeed better in learning how to work problems when they have them, together with explanations, in a separate book.

INITIATION AND GROWTH OF EXPLOSION IN LIQUIDS AND SOLIDS—F. P. Bowder and A. D. Yoffe—*Cambridge University Press*, 104 p., illus., \$4.50. Report of tests showing conditions for safe handling of explosives as well as what makes them go off.

INTRODUCTION TO THE SCIENCE OF CHEMISTRY—Karol J. Mysels and Charles S. Copeland—*Ginn*, 521 p., illus., \$4.75. A first-year college text. The descriptive material is arranged by type of phenomenon rather than by element.

LABORATORY MANUAL TO ACCOMPANY INTRODUCTION TO THE SCIENCE OF CHEMISTRY—Karol J. Mysels and Charles S. Copeland—*Ginn*, 31 experiments, illus., paper, \$1.75. On detachable pages punched to go into a notebook. Record sheets also included.

INTRODUCTORY GENERAL CHEMISTRY—John E. Cavelti—*Blakiston*, 423 p., illus., \$4.50. For a terminal college course or for the chemistry major's first course, with an emphasis on readability which, the author hopes, may help overcome the "shrinking horror" with which otherwise well-educated people often approach science of any kind.

LABORATORY STUDIES IN COLLEGE CHEMISTRY—Joseph A. Babor and Alexander Lehrman—*Crowell*, 227 p., illus., paper, \$2.50. Designed for the

freshman course level, the manual contains 72 experiments with related problems and questions.

ISOTOPES: A Five-Year Summary of Distribution With Bibliography—Atomic Energy Commission—Govt. Printing Office, 451 p., paper, \$1.00. More than 18,900 shipments of radioactive isotopes and 1,500 stable isotopes have gone to users in the U. S. and 1,000 shipments of radioactive isotopes have gone abroad.

MANOMETRIC METHODS AS APPLIED TO THE MEASUREMENT OF CELL RESPIRATION AND OTHER PROCESSES—Malcolm Dixon—Cambridge University Press, 3d ed., 167 p., illus., \$2.00. A laboratory handbook useful to workers without special physico-chemical knowledge.

THE MEASUREMENT AND CONTROL OF TEMPERATURES IN INDUSTRY—R. Royds—Chemical Publishing Co., 260 p., illus., \$5.00. New and important developments in this field necessitated the revision of this book, originally published under the title, *THE MEASUREMENT OF STEADY AND FLUCTUATING TEMPERATURES*.

THE MERCK INDEX OF CHEMICALS AND DRUGS: An Encyclopedia for the Chemist, Pharmacist, Physician and Allied Professions—Merck & Co., 6th ed., 1167 p., \$7.50 regular edition, \$8.00 thumb-index edition. A new edition of this valuable reference work listing some 20,000 names of chemicals and drugs. Includes an up-to-date periodic table, table of radioactive isotopes and other new material.

METHODS OF ANALYSIS OF FUELS AND OILS—J. R. Campbell—Chemical Publishing Co., 216 p., illus., \$4.00. A laboratory guide for students of fuel technology.

METHODS OF EXTRACTING VOLATILE OILS FROM PLANT MATERIAL AND THE PRODUCTION OF SUCH OILS IN THE UNITED STATES—A. F. Sievers—Govt. Printing Office, USDA Technical Bull. #16, Rev. ed., 28 p., illus., paper, 10 cents. Describing methods for extracting orange and lemon oil with sponges and the perfume from flowers with cold solid fats as well as more recently developed methods.

MISCELLANEOUS PHYSICAL AND CHEMICAL TECHNIQUES OF THE LOS ALAMOS PROJECT: Experimental Techniques—Alvin C. Graves and Darol K. Froman—McGraw, 323 p., illus., \$4.00. Another in the National Nuclear Energy Series, describing apparatus and techniques used during the early atomic energy research, some of which are still applicable to present-day laboratory situations.

MODERN CHEMICAL PROCESSES: A Series of Articles Describing Chemical Manufacturing Plants. Volume II.—The Editors of Industrial and Engineering Chemistry—Reinhold, 299 p., illus., \$5.00. Articles originally published in *Industrial and Engineering Chemistry* under the title, "Staff-Industry Collaborative Reports."

THE OXIDATION STATES OF THE ELEMENTS AND THEIR POTENTIALS IN AQUEOUS SOLUTIONS—Wendell M. Latimer—Prentice-Hall, 2d ed., 392 p., \$10.00. Study questions are included in the Appendix so that the book can be used as a text for advanced inorganic chemistry.

PHOSPHORIC ACID, PHOSPHATES AND PHOSPHATIC FERTILIZERS—William H. Waggaman—Reinhold, American Chemical Society Monograph No. 34, 2nd ed., 690 p., illus., \$15.00. This revised edition includes an up-to-date

list of U. S. Patents which relate to the manufacturing and use of phosphorus compounds.

PHYSICAL-CHEMICAL PROPERTIES OF METHANE-NITROGEN MIXTURES—O. T. Bloomer and J. D. Parent—*Institute of Gas Technology*, 35 p., illus., paper, \$3.50. Data necessary for the engineering design of plants to separate nitrogen from natural gas.

THE PREPARATION AND PROPERTIES OF (HYDROXYORGANO)-SILANES AND RELATED COMPOUNDS—John L. Speier—*Mellon Institute*, 8 p., paper, free upon request to publisher, 4400 Fifth Ave., Pittsburgh 12, Pa. Contribution from the multiple fellowship on technical glassware at Mellon Institute.

PRINCIPLES OF CHEMISTRY—Joel H. Hildebrand and Richard E. Powell—*Macmillan*, 6th ed., 444 p., illus., \$7.50. A college text in chemistry as it is taught at the University of California.

PROBLEMS IN PHYSICAL CHEMISTRY—Lars Gunnar Sillen, Paul W. Lange and Carl O. Gabrielson—*Prentice-Hall*, 370 p., \$7.35. To aid the student in becoming familiar with thermodynamic quantities by learning the relations between them and why they change with varying conditions.

PRINCIPLES OF GEOCHEMISTRY—Brian Mason—*Wiley*, 276 p., illus., \$5.00. A text for geology students and students of other sciences. It deals with the chemical make-up of the earth and our universe and the earth's geological history.

PROGRESS IN ORGANIC CHEMISTRY: Volume I—J. W. Cook, Ed.—*Academic Press*, 287 p., illus., \$7.80. Concise descriptions of recent developments in selected fields of the science.

The eight chapters are contributed by nine authors.

SOME APPLICATIONS OF ATOMIC ENERGY IN PLANT SCIENCE—Atomic Energy Commission—*Govt. Printing Office*, 211 p., illus., paper, 50 cents. Reports indicating the harmful effects of radiation on plant growth and also accounts of research with isotopes on plant physiology. This is the same as the eleventh semi-annual report of the U. S. Atomic Energy Commission.

A SURVEY OF THE SULPHUR AND SULPHURIC ACID POSITION—R. Ashton, A. L. Thorogood and D. Neville-Jones—*Her Majesty's Stationery Office*, 25 p., paper, 40 cents. In the present year world production is a million tons short of demand and in 1953 the shortage is expected to double. Here are various plans for conservation of this essential material.

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